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THE PRINCIPLES AND PRACTICE OF MEDICINE

THE PRINCIPLES AND PRACTICE OF MEDICINE

DESIGNED FOR THE USE OF PRACTITIONERS AND STUDENTS OF MEDICINE

BY

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~~SIXTH~~ Revised and reset EDITION LARGELY RE-WRITTEN ~~AND THOROUGHLY REVISED~~ WITH THE ASSISTANCE OF

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1912

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TO THE

Memory of my Teachers:

WILLIAM ARTHUR JOHNSON,

PRIEST OF THE PARISH OF WESTON, ONTARIO.

JAMES BOVELL,

OF THE TORONTO SCHOOL OF MEDICINE, AND OF THE UNIVERSITY OF TRINITY COLLEGE, TORONTO.

ROBERT PALMER HOWARD,

DEAN OF THE MEDICAL FACULTY AND PROFESSOR OF MEDICINE, MCGILL UNIVERSITY, MONTREAL.

PREFACE TO THE EIGHTH EDITION.

In the twenty years that have passed since the publication of the first edition, triennial revisions have appeared regularly, with one exception—to secure protection against an edition pirated in Great Britain, a fifth edition had to be issued not long after the fourth. Comparing the first edition with the present, very little remains of the original work. The essential groundwork has been, as far as possible, my personal experience in hospital and private practice, correlated with the general experience of the profession, as expressed in its literature. To try to keep the book up to date has been a pleasure and an ambition. Adequately to express my appreciation of the generous support accorded by my colleagues is impossible. The printed page has brought me "mind to mind" with men in all parts of the world; and to feel that I may have been helpful in promoting sound knowledge is my greatest satisfaction.

This edition has been rearranged and largely rewritten. I have grouped the infectious diseases in a different order, and considered apart those of which the specific germs are doubtful or undiscovered. The extraordinary growth of our knowledge of this department has necessitated the incorporation of much new matter in every section, particularly in typhoid fever, typhus fever, pneumonia, tuberculosis and syphilis. Properly to present the recent advances many chapters have had to be recast. New sections deal with Leishmaniasis, the Sporotrichoses, the Colon infections, Poliomyelitis, Pellagra, Disorders of Metabolism, Caisson disease, Ochronosis, Hæmochromatosis, the disorders of the organs of internal secretion, and the diseases of the blood.

Dr. A. G. Gibson of Oxford has helped in the rewriting of the section on the heart and arteries. To Dr. H. M. Thomas and Dr. Harvey Cushing I am indebted for aid in the revision of the section on nervous diseases.

My former associate at the Johns Hopkins Hospital, Dr. Thomas McCrae, has revised the sections on treatment, and the section on diseases of the organs of locomotion. He has also seen the work through the press.

Messrs. Appleton have provided a new font of type and a new page.

William Osler.

Oxford.

CONTENTS

SECTION I

Specific Infectious Diseases

	PAGE
A. Bacterial Diseases	1
I. Typhoid Fever	1
II. Colon Bacillus Infections	46
III. The Pyogenic Infections	48
1. Local Infections with the Development of Toxins	48
2. Septiæmia	49
3. Septico-pyæmia	50
4. Terminal Infections	53
IV. Erysipelas	54
V. Diphtheria	57
VI. The Pneumonias and Pneumococcic Infections	74
A. Lobar Pneumonia	74
B. Broncho-pneumonia	101
C. Other Pneumococcic Infections	108
VII. Cerebro-spinal Fever	108
VIII. Influenza	115
IX. Whooping Cough	119
X. Gonococcus Infections	123
XI. Bacillary Dysentery	126
I. Acute Dysentery	129
II. Chronic Dysentery	130
XII. Malta Fever	130
XIII. Cholera Asiatica	132
XIV. The Plague	138
XV. Tetanus	142
XVI. Glanders	146
XVII. Anthrax	148
XVIII. Leprosy	151
XIX. Tuberculosis	154
I. General Etiology and Morbid Anatomy	154
II. Acute Miliary Tuberculosis	167
III. Tuberculosis of the Lymphatic System	174
1. Tuberculosis of the Lymph-glands	174
2. Tuberculosis of the Serous Membranes	178
IV. Pulmonary Tuberculosis	182
1. Acute Pneumonic Tuberculosis of the Lungs	183

		PAGE
	2. Chronic Ulcerative Tuberculosis of the Lungs	187
	3. Fibroid Phthisis	202
	Complications of Pulmonary Tuberculosis	202
	Diagnosis of Pulmonary Tuberculosis	206
	Concurrent Infections and Diseases Associated with Pulmonary Tuberculosis	208
	Peculiarities of Pulmonary Tuberculosis at the Extremes of Life	210
	Modes of Death in Pulmonary Tuberculosis	210
V.	Tuberculosis of the Alimentary Canal	211
VI.	Tuberculosis of the Liver	213
VII.	Tuberculosis of the Brain and Cord	214
VIII.	Tuberculosis of the Genito-urinary System	215
IX.	Tuberculosis of the Mammary Gland	220
X.	Tuberculosis of the Circulatory System	221
XI.	The Prognosis in Tuberculosis	221
XII.	Prophylaxis in Tuberculosis	222
XIII.	Treatment of Tuberculosis	223
B.	Non-Bacterial Fungus Infections—The Mycoses	231
I.	Actinomycosis	232
II.	The Sporotrichoses	234
III.	Nocardiosis	235
IV.	Oïdiomycosis	235
V.	Mycetoma	236
VI.	Aspergillosis	236
C.	Protozoan Infections	237
I.	Psorospermiasis	237
II.	Amœbiasis	237
III.	Malarial Fever	243
IV.	Trypanosomiasis	258
V.	Leishmaniasis	260
VI.	Relapsing Fever	261
VII.	Syphilis	263
	I. History, Etiology, and Morbid Anatomy	263
	II. Acquired Syphilis	266
	III. Congenital Syphilis	268
	IV. Visceral Syphilis	270
	1. Syphilis of the Brain and Cord	270
	2. Syphilis of the Respiratory Organs	272
	3. Syphilis of the Liver	273
	4. Syphilis of the Digestive Tract	275
	5. Circulatory System	275
	6. Renal Syphilis	276
	7. Syphilitic Orchitis	276
	V. Diagnosis, Treatment, Etc.	276
VIII.	Diseases Due to Parasitic Infusoria	281
D.	Diseases Due to Metazoan Parasites	282
I.	Diseases Due to Flukes—Distomiasis	282

		PAGE
II.	Diseases Caused by Cestodes—Tæniasis	284
	1. Intestinal Cestodes; Tapeworms	284
	2. Somatic Tæniasis	287
III.	Diseases Caused by Nematodes	294
	1. Ascariasis	294
	2. Trichiniasis	296
	3. Ankylostomiasis	300
	4. Filariasis	305
	5. Dracontiasis	307
	6. Other Nematodes	308
IV.	Parasitic Arachnida and Ticks	310
V.	Parasitic Insects	311
VI.	Parasitic Flies	313
E.	Infectious Diseases of Doubtful or Unknown Etiology	315
I.	Small-pox	315
II.	Vaccinia (Cow-pox)—Vaccination	326
III.	Varicella (Chicken-pox)	331
IV.	Scarlet Fever	333
V.	Measles	343
VI.	Rubella (German Measles)	348
VII.	Epidemic Parotitis (Mumps)	349
VIII.	Typhus Fever	351
IX.	Yellow Fever	356
X.	Dengue	362
XI.	Acute Polio-myelitis	364
XII.	Hydrophobia	368
XIII.	Rheumatic Fever	371
XIV.	Acute Tonsillitis	380
XV.	Acute Catarrhal Fever	382
XVI.	Febricula—Ephemeral Fever	383
XVII.	Infectious Jaundice	384
XVIII.	Milk-sickness	385
XIX.	Glandular Fever	386
XX.	Miliary Fever (Sweating Sickness)	386
XXI.	Foot and Mouth Disease—Epidemic Stomatitis—Aphthous Fever	387
XXII.	Psittacosis	388
XXIII.	Rocky Mountain Spotted Fever; Tick Fever	388
XXIV.	Swine Fever	388
XXV.	Rat-bite Fever	389

SECTION II

Diseases Due to Physical Agents

I.	Sunstroke; Heat Exhaustion	390
II.	Caisson Disease	393
III.	Mountain Sickness	395

SECTION III

The Intoxications

		PAGE
I.	Alcoholism	396
II.	Morphia Habit	400
III.	Lead Poisoning	402
IV.	Arsenical Poisoning	406
V.	Food Poisoning	407
VI.	Pellagra	411
VII.	Beri-Beri	414

SECTION IV

Diseases of Metabolism

I.	Gout	417
II.	Diabetes Mellitus	426
III.	Diabetes Insipidus	439
IV.	Rickets (Rhachitis)	441
V.	Scurvy	446
	Infantile Scurvy	449
VI.	Obesity	450
VII.	The Lipomatoses	452
VIII.	Hæmochromatosis	453
IX.	Ochronosis	454

SECTION V

Diseases of the Digestive System

A.	Diseases of the Mouth	456
	Stomatitis	456
B.	Diseases of the Salivary Glands	462
C.	Diseases of the Pharynx	464
D.	Diseases of the Tonsils	467
	I. Suppurative Tonsillitis	467
	II. Chronic Tonsillitis	468
E.	Diseases of the Œsophagus	472
	I. Acute Œsophagitis	472
	II. Spasm of the Œsophagus	473
	III. Stricture of the Œsophagus	474
	IV. Cancer of the Œsophagus	475
	V. Rupture of the Œsophagus	475
	VI. Dilatations and Diverticula	476
F.	Diseases of the Stomach	476
	I. Acute Gastritis	476

PAGE

II. Chronic Gastritis 479
III. Cirrhosis Ventriculi 486
IV. Dilatation of the Stomach 486
V. The Peptic Ulcer, Gastric and Duodenal 490
VI. Cancer of the Stomach 498
VII. Hypertrophic Stenosis of the Pylorus 505
VIII. Hæmorrhage from the Stomach 506
IX. Neuroses of the Stomach 509
G. Diseases of the Intestines 516
I. Diseases of the Intestines Associated with Diarrhœa . . . 516
Catarrhal Enteritis; Diarrhœa 516
Diphtheroid or Croupous Enteritis 520
Phlegmonous Enteritis 520
Ulcerative Enteritis 520
II. Diarrhœal Diseases in Children 524
III. Appendicitis 531
IV. Intestinal Obstruction 538
V. Constipation 545
VI. Enteroptosis 548
VII. Miscellaneous Affections 551
I. Mucous Colitis 551
II. Dilatation of the Colon 552
III. Intestinal Sand 553
IV. Diverticulitis—Perisigmoiditis. 553
V. Affections of the Mesentery 553
H. Diseases of the Liver 555
I. Jaundice 555
1. Obstructive Jaundice 555
2. Toxæmic and Hæmolytic Jaundice 557
3. Hereditary Icterus 557
II. Icterus Neonatorum 558
III. Acute Yellow Atrophy 559
IV. Affections of the Blood-vessels of the Liver 561
V. Diseases of the Bile-passages and Gall-bladder 563
I. Acute Catarrh of the Bile-ducts 563
II. Chronic Catarrhal Angiocholitis 564
III. Suppurative and Ulcerative Angiocholitis 565
IV. Acute Infectious Cholecystitis 565
V. Cancer of the Bile-passages 567
VI. Stenosis and Obstruction of the Bile-ducts 567
VI. Cholelithiasis 568
VII. The Cirrhoses of the Liver 575
1. Alcoholic Cirrhosis 576
2. Hypertrophic Cirrhosis 580
3. Syphilitic Cirrhosis 581
4. Capsular Cirrhosis—Perihepatitis 581
VIII. Abscess of the Liver 583
IX. New Growths in the Liver 587

PAGE

X. Fatty Liver 590
XI. Amyloid Liver 590
XII. Anomalies in Form and Position of the Liver 591
I. Diseases of the Pancreas 592
I. Pancreatic Insufficiency 592
II. Pancreatic Necrosis 593
III. Hæmorrhage 593
IV. Acute Pancreatitis 594
V. Chronic Pancreatitis 596
VI. Pancreatic Cysts 597
VII. Tumors of the Pancreas 598
VIII. Pancreatic Calculi 599
J. Diseases of the Peritoneum 600
I. Acute General Peritonitis 600
II. Peritonitis in Infants 603
III. Localized Peritonitis 604
IV. Chronic Peritonitis 606
V. New Growths in the Peritoneum 607
VI. Ascites 608

SECTION VI

Diseases of the Respiratory System

A. Diseases of the Nose 612
I. Autumnal Catarrh (Hay Fever) 612
II. Epistaxis 613
B. Diseases of the Larynx 614
I. Acute Catarrhal Laryngitis 614
II. Chronic Laryngitis 615
III. Œdematous Laryngitis 616
IV. Spasmodic Laryngitis 617
V. Tuberculous Laryngitis 618
VI. Syphilitic Laryngitis 619
C. Diseases of the Bronchi 620
I. Acute Bronchitis 620
II. Chronic Bronchitis 622
III. Bronchiectasis 625
IV. Bronchial Asthma 627
V. Fibrinous Bronchitis 631
D. Diseases of the Lungs 633
I. Circulatory Disturbances in the Lungs 633
II. Chronic Interstitial Pneumonia 639
III. Pneumonokoniosis 642

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PAGE

IV. Emphysema 645
1. Compensatory 645
2. Hypertrophic 646
3. Atrophic 650
4. Acute Vesicular 650
5. Interstitial 650
V. Gangrene of the Lung 650
VI. Abscess of the Lung 652
VII. New Growths in the Lungs 653
E. Diseases of the Pleura 654
I. Acute Pleurisy 654
1. Fibrinous or Plastic Pleurisy 654
2. Sero-fibrinous Pleurisy 655
3. Purulent Pleurisy (Empyema) 660
4. Tuberculous Pleurisy 662
5. Other Varieties of Pleurisy 662
II. Chronic Pleurisy 667
III. Hydrothorax 668
IV. Pneumothorax 669
V. Affections of the Mediastinum 672

Haemothorax. 670
Diaphragm.

SECTION VII

Diseases of the Kidneys

I. Malformations 676
II. Movable Kidney 676
III. Circulatory Disturbances 679
IV. Anomalies of the Urinary Secretion 680
1. Anuria 680
2. Hæmaturia 681
3. Hæmoglobinuria 682
4. Albuminuria 684
5. Bacteriuria 687
6. Pyuria 687
7. Chyluria—Non-parasitic 688
8. Lithuria 688
9. Oxaluria 689
10. Cystinuria 690
11. Phosphaturia 690
12. Indicanuria 691
13. Melanuria 691
14. Alkaptonuria 692
15. Pneumaturia 692
16. Other Substances 693

PAGE

V. Uræmia 693
VI. Acute Bright's Disease 696
VII. Chronic Bright's Disease 702
1. Chronic Parenchymatous Nephritis 702
2. Chronic Interstitial Nephritis 704
VIII. Amyloid Disease 711
IX. Pyelitis 712
X. Hydronephrosis 715
XI. Nephrolithiasis 717
XII. Tumors of the Kidney 722
XIII. Cystic Disease of the Kidney 723
XIV. Perinephric Abscess 725

SECTION VIII

Diseases of the Blood

I. Anæmia 727
Local Anæmia 727
General Anæmia 728
Primary or Essential Anæmia 730
1. Chlorosis 730
2. Idiopathic or Pernicious Anæmia 733
II. Leukæmia 741
III. Hodgkin's Disease 746
IV. Purpura 750
V. Hæmophilia 755
VI. Erythræmia 757
VII. Enterogenous Cyanosis 758

SECTION IX

Diseases of the Circulatory System

A. Diseases of the Pericardium 760
I. Pericarditis 760
Chronic Adhesive Pericarditis 767
II. Other Affections of the Pericardium 769
B. Diseases of the Heart 770
I. Functional Affections of the Heart 770
1. Palpitation 770
2. Arrhythmia 771
3. Fibrillation of the Heart 774
4. Rapid Heart—Tachycardia 776

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PAGE

5. Slow Heart—Bradycardia 777
6. Heart-block—Stokes-Adams' Disease 778

II. Affections of the Myocardium 780
1. Hypertrophy 780
2. Dilatation 782
3. Cardiac Insufficiency 784

III. Endocarditis 797

IV. Chronic Valvular Disease 805
General Introduction 805
Aortic Incompetency 808
Aortic Stenosis 814
Mitral Incompetency 817
Mitral Stenosis 820
Tricuspid Valve Disease 824
Pulmonary Valve Disease 825
Combined Valvular Lesions 826

V. Special Pathological Conditions 828
1. Aneurism of the Heart 829
2. Rupture of the Heart 830
3. New Growths and Parasites 831
4. Wounds and Foreign Bodies 831

VI. Congenital Affections of the Heart 832

VII. Angina Pectoris 836

C. Diseases of the Arteries 841

I. Arterio-sclerosis 841

II. Aneurism 847
Aneurism of the Thoracic Aorta 849
Aneurism of the Abdominal Aorta 859
Aneurism of the Branches of the Abdominal Aorta . . . 860
Arterio-venous Aneurism 861
Polyarteritis Acuta Nodosa 862

SECTION X

Diseases of the Ductless Glands

I. Diseases of the Suprarenal Bodies 863
1. Addison's Disease 863
2. Other Affections of the Suprarenal Glands 867

II. Diseases of the Thymus Gland 868
1. Hypertrophy of the Thymus 868
2. Atrophy of the Thymus 869
3. Status Thymico-lymphaticus 869

III. Diseases of the Thyroid Gland 869
1. Congestion 869

PAGE

2. Thyroiditis 871
3. Tumors of the Thyroid 871
4. Aberrant and Accessory Thyroids 871
5. Goitre 872
6. Hypothyroidism (Cretinism and Myxœdema) 873
7. Hyperthyroidism; Exophthalmic Goitre 877

IV. Diseases of the Parathyroid Glands 880
Tetany 881
V. Diseases of the Spleen 883
1. General Remarks 883
2. Movable Spleen 883
3. Rupture of the Spleen 884
4. Infarct, Abscess, and Cysts of the Spleen 885
5. Primary Splenomegaly with Anæmia 885
VI. Diseases of the Pituitary Body 889
Acromegaly 890
VII. Infantilism 892

SECTION XI

Diseases of the Nervous System

A. General Introduction 894
B. System Diseases 912
I. Introduction 912
II. Diseases of the Afferent or Sensory System 913
1. Locomotor Ataxia 913
2. General Paralysis of the Insane and Tabo-paralysis . . 921
3. Acute Posterior Ganglionitis 926
III. Diseases of the Efferent or Motor Tract 927
A. Of Whole Tract 927
1. Progressive (Central) Muscular Atrophy . . . 927
2. Progressive Neural Muscular Atrophy . . . 931
3. The Muscular Dystrophies 932
B. System Diseases of the Upper Motor Segment . . . 935
1. Spastic Paralysis of Adults 935
2. Spastic Paralysis of Infants—Spastic Diplegia—Birth Palsies 936
3. Hereditary Spastic Paraplegia 937
4. Erb's Syphilitic Spinal Paralysis 939
5. Secondary Spastic Paralysis 939
6. Hysterical Spastic Paraplegia 940
C. System Diseases of the Lower Motor Segment . . . 940
1. Chronic Anterior Polio-myelitis 940

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PAGE

2. Ophthalmoplegia 940
3. Acute Polio-myelitis 940
4. Acute and Subacute Polio-myelitis in Adults . . 941
5. Acute Ascending (Landry's) Paralysis . . . 941

IV. Combined System Diseases 942
1. Ataxia Paraplegia 942
2. Primary Combined Sclerosis (Putnam) 943
3. Hereditary Ataxia 944
4. Progressive Interstitial Hypertrophic Neuritis of Infants . 945
5. Toxic Combined Sclerosis 945

C. Diffuse Diseases of the Nervous System 946
I. Affections of the Meninges 946
Diseases of the Dura Mater 946
Hæmorrhagic Pachymeningitis 946
Diseases of the Pia Mater 948
II. Scleroses of the Brain 951

D. Diffuse and Focal Diseases of the Spinal Cord 954
I. Topical Diagnosis 954
II. Affections of the Blood-vessels 956
1. Congestion 956
2. Anæmia 956
3. Embolism and Thrombosis 957
4. Endarteritis 957
5. Hæmorrhage into the Spinal Membranes; Hæmatorrhachis . 957
6. Hæmorrhage into the Spinal Cord; Hæmatomyelia . . 958
III. Compression of the Spinal Cord 959
IV. Lesions of the Cauda Equina and Conus Medullaris . . . 962
V. Tumors of the Spinal Cord and Its Membranes 963
VI. Syringomyelia 964
VII. Acute Myelitis 965

E. Diffuse and Focal Diseases of the Brain 968
I. Topical Diagnosis 968
II. Aphasia 976
III. Affections of the Blood-vessels 982
1. Cerebral Circulation 982
2. Hyperæmia and Anæmia 985
3. Œdema of the Brain 986
4. Cerebral Hæmorrhage 987
5. Embolism and Thrombosis 998
6. Aneurism of the Cerebral Arteries 1003
7. Endarteritis 1004
8. Thrombosis of the Cerebral Sinuses and Veins . . . 1004
9. Hemiplegia in Children 1006
IV. Tumors, Infections, Granulomata and Cysts of the Brain . . 1009
V. Inflammation of the Brain 1014
1. Acute Encephalitis 1014
2. Abscess of the Brain 1015
VI. Hydrocephalus 1018

PAGE

F. Diseases of the Peripheral Nerves 1020
I. Neuritis 1020
II. Neuromata 1026
III. Diseases of the Cerebral Nerves 1028
Olfactory Nerves and Tracts 1028
Optic Nerve and Tract 1029
1. Lesions of the Retina 1029
2. Lesions of the Optic Nerve 1030
3. Affections of the Chiasma and Tract 1031
4. Affections of the Tract and Centres 1032
Motor Nerves of the Eyeball 1035
Fifth Nerve 1039
Facial Nerve 1041
Auditory Nerve 1045
The Cochlear Nerve 1045
The Vestibular Nerve 1046
Glosso-pharyngeal Nerve 1048
Pneumogastric Nerve 1049
Spinal Accessory Nerve 1052
Hypoglossal Nerve 1054
IV. Diseases of the Spinal Nerves 1055
Cervical Plexus 1055
Brachial Plexus 1057
Lumbar and Sacral Plexuses 1060
Sciatica 1061
G. General and Functional Diseases 1061
I. Paralysis Agitans 1063
Other Forms of Tremor 1066
II. Acute Chorea 1066
III. Other Affections Described as Chorea 1074
IV. Infantile Convulsions 1077
V. Epilepsy 1079
VI. Migraine 1087
VII. Neuralgia 1089
VIII. Professional Spasms; Occupation Neuroses 1093
IX. Hysteria 1095
X. Neurasthenia 1106
XI. The Traumatic Neuroses 1116
XII. Other Forms of Functional Paralysis 1119
H. Vaso-motor and Trophic Disorders 1120
I. Raynaud's Disease 1120
II. Erythromelagia 1123
III. Angio-neurotic Œdema 1123
IV. Persistent Hereditary Œdema of the Legs 1124
V. Facial Hemiatrophy 1125
VI. Scleroderma 1125
VII. Ainhum 1127

SECTION XII

Diseases of the Locomotor System

		PAGE
A.	Diseases of the Muscles	1128
	I. Myositis	1128
	II. Myositis Ossificans Progressiva	1129
	III. Myalgia	1129
	IV. Myotonia	1131
	V. Paramyoclonus Multiplex	1132
	VI. Myasthenia Gravis	1133
	VII. Amyotonia Congenita	1133
B.	Diseases of the Joints	1134
	I. Arthritis Deformans	1134
	II. Intermittent Hydrarthrosis	1143
C.	Diseases of the Bones	1143
	I. Hypertrophic Pulmonary Arthropathy	1143
	II. Osteitis Deformans	1144
	III. Leontiasis Ossea	1145
	IV. Osteogenesis Imperfecta	1145
	V. Osteopsathyrosis	1146
	VI. Achondroplasia	1146
	VII. Oxycephaly	1147

O. Bloomsbury
Hereditary Deformity Chondrodysplasia

CHARTS AND ILLUSTRATIONS

CHART

		PAGE
I.	Typhoid Fever with Relapses	16
II.	Typhoid Fever. Hæmorrhage from the Bowels	23
III.	Fever, Pulse and Respiration in Lobar Pneumonia	82
IV.	Blood Count in Pneumonia and Comparative Mortality	87
V.	Chronic Tuberculosis	198
VIa.	Double Tertian Infection. Quotidian Fever	250
VIb.	Æstivo-autumnal Infection. Remittent Fever	250
VIc.	Æstivo-autumnal Fever. Quotidian Paroxysms	251
VId.	Quartan Fever	251
VII.	Malaria Cases Among the Employees of the Isthmian Canal Commission, 1906-1910	256
VIII.	Relapsing Fever (Murchison)	262
IX.	Small-pox (Strümpell)	318
X.	Scarlet Fever	336
XI.	Measles	345
XII.	Typhus Fever (Murchison)	354
XIII.	Case of Sun Stroke Treated by the Ice-bath; Recovery	392
XIV.	Uric Acid and Phosphoric Acid Output in Case of Acute Gout	410
XV.	Illustrating Influence of Diet on Sugar and Amount of Urine	437
XVI.	Blood Chart in Purpura Hæmorrhagica	729
XVII.	Chlorosis	731
XVIII.	Pernicious Anæmia	737
XIX.	Leukæmia	744
XX.	Blood Chart of Anæmia in Purpura Hæmorrhagica	753

FIGURE

1.	A "Nodal" Extra-systole	773
2.	Extra-systoles of Ventricular Type	773
3.	Extra-systoles Followed by Ventricular Contractions	774
4.	Pulse Tracing from a Case of Auricular Fibrillation	775
5.	Diagram Showing the Sino-auricular Node and the Auricular Bundle	778
6.	Diagrams after Martius, Showing Schematically the Power of the Heart Muscle	806
7.	Schematic Division of the Phases of the Heart's Action	808
8.	Pulse Tracing in Aortic Insufficiency; Extra-systole	813
9.	Pulse Tracing in Aortic Stenosis	816
10.	Diagram of Motor Path from Left Brain (van Gehuchten)	896

FIGURE		PAGE
11.	Diagram of Motor Path from Each Hemisphere (van Gehuchten)	897
12.	Diagrams of Cerebral Localization	900
13.	Diagram of Motor and Sensory Representation in the Internal Capsule	902
14.	Diagram of Motor and Sensory Paths in Crura	902
15.	Diagram of Cross-section of the Spinal Cord	902
16.	Anterior Aspect of the Segmental Skin-fields of the Body	906
17.	Posterior Aspect of the Segmental Skin-fields of the Body	907
18.	Diagram of Motor Path from Left Brain	993
19.	Diagram of Visual Paths (Violet)	1033

THE PRINCIPLES AND PRACTICE OF MEDICINE

SECTION I

SPECIFIC INFECTIOUS DISEASES

A. BACTERIAL DISEASES

I. TYPHOID FEVER

Definition.—A general infection caused by the bacillus typhosus, characterized anatomically by hyperplasia and ulceration of the intestinal lymph-follicles, swelling of the mesenteric glands and spleen, and parenchymatous changes in the other organs. There are cases in which the local changes are slight or absent, and there are others with intense localization in the lungs, spleen, kidneys, or cerebro-spinal system. Clinically the disease is marked by fever, a rose-colored eruption, diarrhœa, abdominal tenderness, tympanites, and enlargement of the spleen; but these symptoms are extremely inconstant, and even the fever varies in its character.

Historical Note.—Huxham, in his remarkable Essay on Fevers, had "taken notice of the very great difference there is between the *putrid malignant* and the *slow nervous fever.*" In 1813 Pierre Bretonneau, of Tours, distinguished "dothiénentérite" as a separate disease; and Petit and Serres described entero-mesenteric fever. In 1829 Louis' great work appeared, in which the name "typhoid" was given to the fever. At this period typhoid fever alone prevailed in Paris and many European cities, and it was universally believed to be identical with the continued fever of Great Britain, where in reality typhoid and typhus coëxisted. The intestinal lesion was regarded as an accidental occurrence in the course of ordinary typhus. Louis' students returning to their homes in different countries, had opportunities for studying the prevalent fevers in the thorough and systematic manner of their master. Among these were certain young American physicians, to one of whom, Gerhard, of Philadelphia, is due the great honor of having first clearly laid down the differences between the two diseases. His papers in the American Journal of the Medical Sciences, 1837, are the first which give a full and satisfactory account of their clinical and anatomical distinctions. The studies of James Jackson, Sr. and Jr., of Enoch Hale and of George C. Shattuck, of

Boston, and of Alfred Stillé and Austin Flint made the subject very familiar in American medicine. In 1842 Elisha Bartlett's work appeared, in which, for the first time in a systematic treatise, typhoid and typhus fever were separately considered with admirable clearness. In Great Britain the recognition of the difference between the two diseases was very slow, and was due largely to A. P. Stewart, and finally, to the careful studies of Jenner between 1849 and 1850.

Etiology.—General Prevalence.—Typhoid fever prevails especially in temperate climates, in which it constitutes the most common continued fever. Widely distributed throughout all parts of the world, it probably presents everywhere the same essential characteristics, and is everywhere an index of the sanitary intelligence of a community. *Imperfect sewerage* and *contaminated water-supply* are two special conditions favoring the distribution of the bacilli; *filth, overcrowding,* and *bad ventilation* are accessories in lowering the resistance of the individuals exposed. While from an infected person the disease may be spread by *fingers, food* and *flies.*

In *England and Wales* in 1911 the disease was fatal to 1,848 persons, a mortality of 36 per million of living persons. It destroys more lives in proportion to population in towns than in the country. The rate was lower in 1911 than in any year since 1869. Compared with the quinquennial average, there was a very marked reduction.

In *India* the disease is very prevalent; no race or creed is exempt, and 80 per cent. of the cases of continued fever lasting three weeks prove to be typhoid fever (L. Rogers).

In the *United States* typhoid fever continues to be disgracefully prevalent. From 1900 to 1909 the death rate in the registration areas was 29.5 per 100,000. It is estimated that from 35,000 to 40,000 persons die of it every year, so that at a moderate estimate nearly one half-million people are attacked annually. It is more prevalent in country districts than in cities, and, as Fulton has shown, the propagation is largely from the country to the town. What is needed both in Canada and the United States is a realization by the public that certain primary laws of health must be obeyed.

In *Germany* the larger cities have comparatively little typhoid fever. The story of Hamburg, as told by Reincke (Lancet, i, 1904), should be read by all interested in the disease. During the past twenty-five years the death rate in Prussia has been reduced from an average of over 6 to less than 2 per 10,000 of the population. It is still very prevalent in some of the country districts.

Typhoid fever has been one of the great scourges of the armies, and kills and maims more than powder and shot. The story of the recent wars forms a sad chapter in human inefficiency.

In the Spanish-American War the report of the Commission (Reed, Vaughan, and Shakespeare) shows that one-fifth of the soldiers in the national encampments had typhoid fever—among 107,973 men there were 20,738 cases, with 1,580 deaths. In 90 per cent. of the volunteer regiments the disease broke out within eight weeks after going into camp. In the opinion of the Commission the most important factors were camp pollution, flies as carriers of contagion, and the contamination through the air in the form of dust.

In the South African War the British army, 557,653 officers and men, had

Nov 13

Paratyphoid. cf B. M. J. 1915. I. 722. etc.

of 1363 cases "enteric" - 910 paratyphoid -

Confirmation in both A. & B.

Bacteriaemia of short duration - especially in A.

agglut. trace. A. 1 in 10 dilution.

Hemorrhage. common in B. than A. cf B earlier than A typhoid.

B. seems specially to attack the Lung.

1915 - 1388 deaths. 35 per million.

In New York city - death rate enteric 10.4 in Jan to 1.1 in Aug

In 1916 death rate for the corresponding [illegible]

The present war shows the results of prevention in a striking way.

and the present European war.

Some reminiscences and instances of paralytic[illegible] forces.

57,684 cases of enteric fever, with 8,225 deaths (Simpson), while only 7,582 men died of wounds received in battle. As in America, the disease was essentially one of the standing camps; troops constantly on the move were rarely much affected. While contaminated water was no doubt an important factor, as it always is in camp pollution, yet certain of the conditions in Africa were peculiar. Fæcal and urinary contamination must have been very common, as in the cooking, performed in the open air, sand "entered largely into every article of food." As there was a perfect plague of flies, they were without doubt a very important factor in the infection of both food and drink.

On the other hand, the Japanese and Russian War demonstrated the remarkable efficiency of modern hygiene, if carried out in an intelligent manner. No great war has ever been conducted with such forethought for the preservation of the fighting unit, and in consequence the mortality from typhoid fever and dysentery was exceptionally low.

Season.—Almost without exception the disease is ~~everywhere~~ more prevalent in the autumn, hence the old popular name autumnal fever. The ~~exhaustive~~ study of this question by Sedgwick and Winslow shows everywhere a striking parallelism between the monthly variations in temperature and the prevalence of the disease. In a few cities the curves are irregular, showing, in addition to the usual summer rise, two secondary maxima in the winter and spring, and these authors suggest that epidemics at these seasons are characteristic of cities whose water-supply is most subject to pollution. In their opinion "the most reasonable explanation of the seasonal variations of typhoid fever is a direct effect of the temperature upon the persistence in nature of the germs which proceed from previous victims of the disease."

Of 1,500 cases at the Johns Hopkins Hospital (upon the study of which this section is based), 840 were in August, September, and October.

Sex.—Males and females are equally liable to the disease, but males are much more frequently admitted into hospitals, 2.4 to 1 in our series.

Age.—Typhoid fever is a disease of youth and early adult life. The greatest susceptibility is between the ages of fifteen and twenty-five. Of 1,500 cases treated in my wards ~~at the Johns Hopkins Hospital~~ there were under fifteen years of age, 231; between fifteen and twenty, 253; between twenty and thirty, 680; between thirty and forty, 227; between forty and fifty, 88; between fifty and sixty, 8; above sixty, 11; age not given, 1. Cases are rare over sixty, although Manges believes that they are more common than the records show. As the course is often atypical the diagnosis may be uncertain and the disease not recognized until autopsy. It is not very infrequent in childhood, but infants are rarely attacked. Murchison saw a case at the sixth month. ~~There is no evidence that the disease is congenital even in cases in which the mother has contracted it late in pregnancy.~~

Immunity.—Not all exposed to the infection take the disease. Some families seem more susceptible than others. One attack usually protects. Two attacks have been described within a year. ~~"Of 2,000 cases of enteric fever at the Hamburg General Hospital, only 11 persons were affected twice and only 1 person three times" (Dreschfeld).~~ In 500 of our cases in which special inquiry was made as to a previous attack, it was found to have occurred in 11 (2.2 per cent.). The interval varied from nine months to thirty years. It is well known that usually within a short time after recovery the immune

substances disappear from the blood, yet in most cases the relative immunity lasts a long time, frequently for life. An experimental explanation for this fact has been given in the demonstration that animals which have once reacted to the typhoid infection, react in throwing out immune substances more quickly and in larger amounts when danger again threatens (Cole).

Bacillus typhosus.—The researches of Eberth, Koch, Gaffky, and others have shown that there is a special micro-organism *constantly* associated with typhoid fever.

(*a*) *General Characters.*—It is a rather short, thick, flagellated, motile bacillus, with rounded ends, in one of which, sometimes in both (particularly in cultures), there can be seen a glistening round body, at one time believed to be a spore; but these polar structures are probably only areas of degenerated protoplasm. It grows readily on various nutritive media, and can now be differentiated from *Bacillus coli*, with which, and with certain other bacilli, it is apt to be confounded. This organism now fulfills all the requirements of Koch's law—it is constantly present, and it grows outside the body in a specific manner; the third requirement, the production of the disease experimentally, has been successfully met by the conveyance of the disease to chimpanzees. The bacilli or their toxins inoculated in large quantities into the blood of rabbits are pathogenic, and in some instances ulcerative and necrotic lesions in the intestine may be produced. But similar intestinal lesions may be caused by other bacteria, including *Bacillus coli*.

Cultures are killed within ten minutes by a temperature of 60° C. They may live for eighteen weeks at —5° C., although most die within two weeks, and all within twenty-two weeks (Park). The typhoid bacillus resists ordinary drying for months, unless in very thin layers, when it is killed in five to fifteen days. The direct rays of the sun completely destroy them in from four to ten hours' exposure. Bouillon cultures are destroyed by carbolic acid, 1 to 200, and by corrosive sublimate, 1 to 2,500.

(*b*) *Distribution in the Body.*—During recent years our ideas in regard to the distribution of the typhoid bacilli have been much modified, owing to the demonstration that in practically all cases the bacilli enter the circulating blood and are carried throughout the body. During life they may be demonstrated in the circulating blood in a large proportion of cases, in 75 per cent. of 604 collected cases (Coleman and Buxton). They occur in the urine in from 25 to 30 per cent. of the cases. They may be isolated from the stools in practically all cases at some stage. They are probably always present in the rose spots. They are reported to have been cultivated from the sweat, and they undoubtedly occur with considerable frequency in the sputum (Richardson, Rau, and others). At autopsy they are found widely distributed, most numerous and constant usually in the mesenteric glands, spleen, and gall-bladder, but are found in almost all organs, even the muscles, uterus, and lungs (von Drigalski). Cultures made from the intestines at autopsy (according to Jürgens, and also von Drigalski) show that they are very few or can not be cultivated from the rectum up to the cæcum, but above this they increase in number, being very numerous in the duodenum and jejunum, and practically constant in cultures made from the mucous membrane of the stomach. They are also present in the œsophagus and frequently on the tongue and tonsils. From endocardial vegetations, from

There are various clinical which show antigenic differences
and ∴ unfully valent [illegible]

ils

wml

meningeal and pleural exudates and from foci of suppuration in various parts of the body, the bacilli have also been isolated. A most important and remarkable fact is that at times they may be present in the stools of persons who show no symptoms of typhoid fever, but who have lived in very close association with typhoid-fever patients. This is especially true of children.

(*c*) *The Bacilli outside the Body.*—In sterile water the bacilli retain their vitality for weeks, but under ordinary conditions, in competition with saprophytes, disappear within a few days. The question of the longevity of the typhoid bacillus in water is of great importance, and has been much discussed in connection with the supposed pollution of the water of the Mississippi by the Chicago drainage canal. The experiments of E. O. Jordan would indicate that the vitality was retained as a rule not longer than three days after infection. Whether an increase can occur in water is not finally settled. Their detection in the water is difficult, and although they undoubtedly have been found, many such discoveries previously reported are not certain on account of the inaccurate differentiation of the typhoid bacillus and varieties of the intestinal bacilli closely resembling it. Both Prudden and Ernst have found it in water filters.

There are cities deriving their ice supply from polluted streams with low death rates from typhoid fever. Sedgwick and Winslow conclude from their careful study that very few typhoid germs survive in ice. The Ogdensburg epidemic in 1902-'03 was apparently due to infection from ice. Typhoid bacilli were grown from frozen material in it (Hutchins and Wheeler).

In *milk* the bacilli undergo rapid development without changing its appearance. They may persist for three months in sour milk, and may live for several days in butter made from infected cream.

Robertson has shown that under entirely natural conditions typhoid bacilli may live in the upper layers of the soil for eleven months. Von Drigalski says if stools which contain typhoid bacilli are kept at room temperature the *B. typhosus* disappears in a few days.

The direct infection by dust of exposed food-stuffs, such as milk, is very probable. The bacilli retain their vitality for many weeks; in garden earth twenty-one days, in filter-sand eighty-two days, in dust of the street thirty days, on linen sixty to seventy days, on wood thirty-two days; on thread kept under suitable conditions for a year.

Modes of Conveyance.—(*a*) *Contagion.*—Direct aerial transmission does not seem probable. Each case should be regarded as a possible source of infection, and in houses, hospitals, schools, and barracks a widespread epidemic may arise from it. Fingers, food, and flies are the chief means of local propagation. It is impossible for a nurse to avoid finger contamination, and without scrupulous care the germs may be widely distributed in a ward or throughout a house. Cotton or rubber gloves are used in some institutions. Even with special precautions and an unusually large proportion of nurses to patients, we have not been able to avoid "house" infection at the Johns Hopkins Hospital. T. B. Futcher has analyzed the 31 cases contracted in the hospital among our first 1,500 cases; physicians, 5 * among a total of

* Only three of these were in attendance on typhoid cases. Two of the five died.—Oppenheimer and Ochsner.

288; nurses, 15 of a total of 407; patients, 8 out of a total of 47,956 admissions; 4 of these occurred in a small ward epidemic. Two orderlies were infected while caring for typhoid patients, and one woman in charge of a supply room, where she only handled clean linen. Newman concludes from his study of typhoid fever in London that direct personal infection, and infection through food are the two common channels for its propagation.

(*b*) *Infection of water* is the most common source of widespread epidemics, many of which have been shown to originate in the contamination of a well or a spring. A striking one occurred at Plymouth, Pa., in 1885, which was investigated by Shakespeare. The town, with a population of 8,000, was in part supplied with drinking-water from a reservoir fed by a mountain stream. During January, February, and March, in a cottage by the side of and at a distance of from 60 to 80 feet from this stream, a man was ill with typhoid fever. The attendants were in the habit at night of throwing out the evacuations on the ground toward the stream. During these months the ground was frozen and covered with snow. In the latter part of March and early in April there was considerable rainfall and a thaw, in which a large part of the three months' accumulation of discharges was washed into a brook, not 60 feet distant. At the very time of this thaw the patient had numerous and copious discharges. About the 10th of April cases of typhoid fever broke out in the town, appearing for a time at the rate of fifty a day. In all about 1,200 people were attacked. An immense majority of all the cases were in the part of the town which received water from the infected reservoir.

The experience of Maidstone in 1897 illustrates the widespread and serious character of an epidemic when the water-supply becomes badly contaminated. The outbreak began about the middle of September, and within the first two weeks 509 cases were reported. By October 27th there were 1,748 cases, and by November 17th 1,848 cases. In all, in a population of 35,000, about 1,900 persons were attacked.

(*c*) *Typhoid Carriers.*—The bacilli may persist for years in the bile passages and intestines of persons in good health. They have been found by Young in the urinary bladder, and by Hunner in the gall-bladder, ten and twenty years after the fever, and there have been cases of typhoid bone lesion from which the bacilli were isolated many years after the primary attack. Within the past few years the work of Strassburg observers has called attention to a group of chronic typhoid carriers of the first importance in the spread of the disease. One woman, a baker, had typhoid fever ten years previously. The bacilli were found in large numbers in her stools. Every new employee in the bakery sooner or later became seriously ill with typhoid-like symptoms, and in two persons the disease proved fatal. Several localized epidemics have been traced to these carriers, particularly in asylums, as determined by the Strassburg observers. Soper reports an instance in which a cook, apparently in perfect health, but in whose stools bacilli had been present in large numbers, had been responsible for the occurrence of typhoid in seven households in five years. Apparently there is no limit to the length of time in which the bacilli may remain in the bile passages and pass into the stools. Dean reports a case of a carrier of twenty-nine years' standing, and instances of even longer duration are recorded. The paratyphoid bacillus may be car-

ried in the same way. An epidemic of 19 cases in a French barrack was traced to a cook who was infected with a paratyphoid bacillus.

(*d*) *Infection of Food.*—Milk may be the source of infection. One of the most thoroughly studied epidemics due to this cause was that investigated by Ballard in Islington. The milk may be contaminated by infected water used in cleaning the cans. The milk epidemics have been collected by Ernest Hart and by Kober.

The germs may be conveyed in ice, salads of various sorts, etc. The danger of eating celery and other uncooked vegetables, ~~which have~~ grown in soil on which infected material has been used as a fertilizer, must not be forgotten.

Much attention has been paid ~~of late years~~ to the *oyster* as a source of infection. In several epidemics, such as that in Middletown, reported by Conn, that in Naples, by Lavis, and in the outbreak which occurred at Winchester, the chain of circumstantial evidence seems complete. Most suggestive sporadic cases have ~~also~~ been recorded by Broadbent and others. Foote showed that oysters taken from the feeding-grounds in rivers contain a larger number of micro-organisms of all sorts than those from the sea. Chantemesse found typhoid bacilli in oysters which had lain in infected sea-water, even after they had been transferred to and kept in fresh water for a time. C. W. Field, working in the laboratories of the Department of Health, New York (1904), confirms the observations of both Foote and Chantemesse, but he could not determine that the bacilli were able to multiply within the oysters. Mosny, in his report to the French Government (1900), admits the possibility of oyster infection, but ~~he~~ thinks that the oyster plays a very small *rôle* in relation to the total morbidity of the disease. Mussels have ~~also~~ been found contaminated with typhoid bacilli, and it is stated that dried fish have carried the infection.

(*e*) *Flies.*—The importance of flies in the transmission of the disease was brought out very strongly in the Spanish-American War in 1898. The Report of the Commission ~~(Reed, Vaughan, and Shakespeare)~~ states that "flies were undoubtedly the most active agents in the spread of typhoid fever. Flies alternately visited and fed on the infected fæcal matter and the food in the mess-tent. . . . Typhoid fever was much less frequent among members of the messes who had their mess-tents screened than it was among those who took no such precautions." In the South African War there was a perfect plague of flies, particularly in the typhoid fever tents, and among the army surgeons the opinion was universal that they had a great deal to do with the dissemination of the disease. Firth and Horrocks demonstrated the readiness with which flies, after feeding on typhoid stools or fresh cultures of typhoid bacilli, could infect sterile media. One of the most interesting studies ~~on the question~~ was made in the Chicago epidemic of 1902 by Alice Hamilton. Flies caught in two undrained privies, on the fences of two yards, on the walls of two houses, and in the room of a typhoid-fever patient, were used to inoculate eighteen tubes, and from five of these tubes typhoid bacilli were isolated.

(*f*) *Contamination of the Soil.*—Filth, bad sewers, or cesspools can not in themselves cause typhoid fever, but they furnish the conditions suitable for the preservation of the bacillus, and possibly for its propagation.

Dust may be an important factor, though it has been shown that the bacilli die very quickly when desiccated. In the dust storms during the South African War the food was often covered with dust. Possibly, too, as Barringer suggests, the dust on the railway tracks may become contaminated. Men working on the tracks are very liable to infection.

Modes of Infection.—We may recognize the following groups: (*a*) *Ordinary typhoid fever with marked enteric lesions.* An immense majority of all the cases are of this character; and while the spleen and mesenteric glands are involved the lymphatic apparatus of the intestinal walls bears the brunt of the attack. (*b*) *Cases in which the intestinal lesions are very slight,* and may be found only after a very careful search. In reviewing the cases of "typhoid fever without intestinal lesions," Opie and Bassett call attention to the fact that in many negative cases slight lesions really did exist, while in others death occurred so late that the lesions might have healed. In some cases the disease is a general septicæmia with symptoms of severe intoxication and high fever and delirium. In others the main lesions may be in organs—liver, gall-bladder, pleura, meninges, or even the endocardium. (*c*) *Cases in which the typhoid bacillus enters the body without causing any lesion of the intestine.* In a number of the earlier cases reported as such the demonstration of the typhoid bacillus was inconclusive. In others the intestine showed tuberculous ulcers, through which the organisms may have entered. But after excluding all these, a few cases remain in which the demonstration of the typhoid bacillus was conclusive, cases in which death occurred early, and yet after a very careful search no intestinal lesions could be found. There were 4 cases in this series. Undoubtedly the intestinal lesions may be so slight as not to be recognizable at autopsy. (*d*) *Mixed infections.* It is well to distinguish, as Dreschfeld pointed out, between double infections, as with bacillus tuberculosis, the diphtheria bacillus, and the plasmodia of Laveran, in which two different diseases are present and can be readily distinguished, and the true mixed or secondary infections, in which the conditions induced by one organism favor the growth of other pathogenic forms; thus in ordinary typhoid fever secondary infection with the colon bacillus, the streptococcus, staphylococcus, or the pneumococcus, is quite common. (*e*) *Para-typhoid infections.* In 1898 Gwyn reported a remarkable case from my clinic, which presented all of the clinical features of typhoid fever, but in which no serum reaction with *B. typhosus* was present. From the blood of this patient he isolated in pure culture a bacillus, differing from *B. typhosus,* but having properties intermediate between *B. typhosus* and *B. coli.* This organism resembled one which was isolated in 1897 by Widal from an œsophageal abscess, and which he called a para-colon bacillus. In 1900 Cushing reported from the Johns Hopkins Hospital the cultivation of a similar organism from a costochondral abscess following an attack resembling typhoid fever. These organisms belong in a group which also contains *B. enteritidis,* described as the cause of meat poisoning, and also several varieties causing diseases in animals. Since 1900, following the introduction of more accurate bacteriological methods, similar organisms have been cultivated from numerous cases (now many hundreds) clinically like mild typhoid. Enlargement of the spleen has been quite constantly present, while rose spots have been frequently seen, and intestinal symptoms, even hæmorrhages, have occurred, but perforation

has not been met with. Many cases have a very brief but acute course, resembling food poisoning. The sequelæ of ordinary typhoid fever may occur, and the para-typhoid organism has been isolated from the lesions of osteomyelitis, an inflamed testis, and a chondrosternal abscess. In the ordinary work of a medical clinic the cases are not very common. There were only 8 in the last 500 cases in my series. There have been about 15 autopsies (Birt), usually with intestinal lesions. There is nothing in the clinical or anatomical features to differentiate these cases from ordinary typhoid, and for practical purposes they may be considered the same disease. The question is a bacteriological one, and the diagnosis rests upon the cultural peculiarities of the organism isolated from the blood or stools, and upon the agglutination tests. (*f*) *Local infections.* The typhoid bacillus may cause a local abscess, cystitis, or cholecystitis without evidence of a general infection. (*g*) *Terminal typhoid infections.* In rare instances the bacillus causes a fatal infection towards the end of other diseases. The subjects may, of course, be typhoid carriers. In two cases of malignant disease at the Johns Hopkins Hospital the bacilli were isolated from the blood, and there were no intestinal lesions.

Products of the Growth of the Bacilli.—Brieger isolated from cultures a poison belonging to the group of ptomaines—typhotoxin. Later he and Fraenkel isolated a poison belonging to the group of toxalbumins. According to Pfeiffer, the chief poison belongs to the intracellular group of toxins. Sidney Martin has isolated a poison which is in the nature of a secretion, but does not differ from that contained within the bacterial cell. Injected into animals it causes lowering of temperature, diarrhœa, loss of weight, and degeneration of the myocardium. Its chemical nature is not known. Similar, but weaker, poisons may also be isolated from cultures of *Bacillus coli* and other members of this group. No toxins have yet been isolated which cause changes in animals at all comparable to typhoid fever in human beings. Macfadyen and Rowland, by mechanically breaking up the bacilli after they had been frozen by means of liquid air, obtained toxins, which injected into monkeys had both antitoxic and antibacterial properties.

Morbid Anatomy.—Intestines.—A catarrhal condition exists throughout the small and large bowel. Specific changes occur in the lymphoid elements, chiefly at the lower end of the ileum. The alterations which occur are most conveniently described in four stages:

(*a*) *Hyperplasia,* which involves the glands of Peyer in the jejunum and ileum, and to a variable extent those in the large intestine. The follicles are swollen, grayish-white, and the patches may project 3 to 5 mm., or may be still more prominent. The solitary glands, which range in size from a pin's head to a pea, are usually deeply imbedded in the submucosa, but project to a variable extent. Occasionally they are very prominent, and may be almost pedunculated. Microscopic examination shows at the outset a condition of hyperæmia of the follicles. Later there is a great increase and accumulation of cells of the lymph-tissue which may even infiltrate the adjacent mucosa and the muscularis; and the blood-vessels are more or less compressed, which gives the whitish, anæmic appearance to the follicles. The cells have all the characters of ordinary lymph-corpuscles. Some of them, however, are larger, epithelioid, and contain several nuclei. Occasionally cells containing red blood-corpuscles are seen. This so-called medullary infiltration, which is

always more intense toward the lower end of the ileum, reaches its height from the eighth to the tenth day and then undergoes one of two changes, *resolution* or *necrosis*. Death very rarely takes place at this stage. Resolution is accomplished by a fatty and granular change in the cells, which are destroyed and absorbed. A curious condition of the patches is produced at this stage, in which they have a reticulated appearance, the *plaques à surface réticulée*. The swollen follicles in the patch undergo resolution and shrink more rapidly than the surrounding framework, or what is more probable the follicles alone, owing to the intense hyperplasia, become necrotic and disintegrate, leaving the little pits. In this process superficial hæmorrhages may result, and small ulcers may orginate by the fusion of these superficial losses of substance.

Except histologically there is nothing distinctive in the hyperplasia of the lymph-follicles; but apart from typhoid fever we rarely see in adults a marked affection of these glands with fever. In children, however, it is not uncommon when death has occurred from intestinal affections, and it is also met with in measles, diphtheria, and scarlet fever.

(*b*) *Necrosis and Sloughing.*—When the hyperplasia of the lymph-follicles reaches a certain grade, resolution is no longer possible. The blood-vessels become choked, there is a condition of anæmic necrosis, and sloughs form which must be separated and thrown off. The necrosis is probably due in great part to the direct action of the bacilli. According to Mallory, there occurs a proliferation of endothelial cells due to the action of a toxin. These cells are phagocytic in character, and the swelling of the intestinal lymphoid tissue is due almost entirely to their formation. The necrosis, he thinks, is due to the occlusion of the veins and capillaries by fibrinous thrombi, which owe their origin to degeneration of phagocytic cells beneath the lining endothelium of the vessels. The process may be superficial, affecting only the upper part of the mucous coat, or it may extend to and involve the submucosa. The "slough" may sometimes lie upon the Peyer's patch, scarcely involving more than the epithelium (Marchand). It is always more intense toward the ileo-cæcal valve, and in very severe cases the greater part of the mucosa of the last foot of the ileum may be converted into a brownish-black eschar. The necrotic area in the solitary glands forms a yellowish cap which often involves only the most prominent point of a follicle. The extent of the necrosis is very variable. It may pass deep into the muscular coat, reaching to or even perforating the peritoneum.

(*c*) *Ulceration.*—The separation of the necrotic tissue—the sloughing—is gradually effected from the edges inward, and results in the formation of an ulcer, the size and extent of which are directly proportionate to the amount of necrosis. If this be superficial, the entire thickness of the mucosa may not be involved and the loss of substance may be small and shallow. More commonly the slough in separating exposes the submucosa and muscularis, particularly the latter, which forms the floor of a majority of all typhoid ulcers. It is not common for an entire Peyer's patch to slough away, and a perfectly ovoid ulcer opposite to the mesentery is rarely seen. Irregularly oval and rounded forms are most common. A large patch may present three or four ulcers divided by septa of mucous membrane. The terminal 6 or 8 inches of the mucous membrane of the ileum may form a

among 6815 autopsies & 834 cases of perf. (12%)

139 perf. among 5891 cases

G. Gibbon

large ulcer, in which are here and there islands of mucosa. The edges of the ulcer are usually swollen, soft, sometimes congested, and often undermined. At a late period the ulcers near the valve may have very irregular sinuous borders. The base of a typhoid ulcer is smooth and clean, being usually formed of the submucosa or of the muscularis.

There may be large ulcers near the valve and swollen hyperæmic patches of Peyer in the upper part of the ileum.

(*d*) *Healing.*—This begins with the development of a thin granulation tissue which covers the base. Occasionally an appearance is seen as if an ulcer had healed in one place and was extending in another. The mucosa gradually extends from the edge, and a new growth of epithelium is formed. The glandular elements are reformed; the healed ulcer is somewhat depressed and is usually pigmented. In death during relapse healing ulcers may be seen in some patches with fresh ulcers in others.

We may say, indeed, that healing begins with the separation of the sloughs, as, when resolution is impossible, the removal of the necrosed part is the first step in the process of repair. In fatal cases, we seldom meet with evidences of cicatrization, as the majority of deaths occur before this stage is reached. It is remarkable that no matter how extensive the ulceration has been, healing is never associated with stricture, and typhoid fever does not appear as one of the causes of intestinal obstruction. Within a very short time all traces of the old ulcers disappear.

Large Intestine.—The cæcum and colon are affected in about one-third of the cases. Sometimes the solitary glands are greatly enlarged. The ulcers are usually larger in the cæcum than in the colon.

Perforation of the Bowel.—*Incidence at Autopsy.*—J. A. Scott's figures, embracing 9,713 cases from recent English, Canadian, and American sources, give 351 deaths from perforation among 1,037 deaths from all causes, a percentage of 33.8 of the deaths and 3.6 of the cases. The German statistics give a much lower proportion of deaths from perforation; Munich in 2,000 autopsies, 5.7 per cent. from perforation; Basle in 2,000 autopsies, 1.3 per cent. from perforation; Hamburg in 3,686 autopsies, 1.2 per cent. from perforation (Hector Mackenzie, Lancet, 1903). At the Johns Hopkins Hospital among 1,500 cases of typhoid fever there were 43 with perforation. Twenty of these were operated upon, with 7 recoveries. One other case died of the toxæmia on the eighth day after operation. At the Pennsylvania Hospital there were 50 cases of perforation among 1,948 cases. Chomel remarks that "the accident is sometimes the result of ulceration, sometimes of a true eschar, and sometimes it is produced by the distention of the intestine, causing the rupture of tissues weakened by disease." As a rule, sloughs are adherent about the site of perforation. The site is usually in the ileum, 232 times in Hector Mackenzie's collection of 264 cases; the jejunum twice, the large intestine 22 times, and the appendix 9 times in his series. As a rule, the perforation occurs within twelve inches of the ileo-cæcal valve. There may be two or three separate perforations. J. A. Scott describes two distinct varieties: first, the more common single, circular, pin-point in size, due to the extension of a necrotic process through the base of a small ulcer. The second variety, produced by a large area of tissue becoming necrotic, ranges in size from the finger-tip to 3 cm. in diameter.

Death from hæmorrhage occurred in 99 of the Munich cases, and in 12 of 137 deaths in my 1,500 cases. The bleeding seems to result directly from the separation of the sloughs. I was not able in any instance to find the bleeding vessel. In one case only a single patch had sloughed, and a firm clot was adherent to it. The bleeding may also come from the soft swollen edges of the patch.

The *mesenteric glands* show hyperæmia and subsequently become greatly swollen. Spots of necrosis are common. In several of my cases suppuration had occurred, and in one a large abscess of the mesentery was present. The rupture of a softened or suppurating mesenteric gland, of which there are only a few cases in the literature, may cause either fatal hæmorrhage or peritonitis. LeConte has successfully operated upon the latter condition. The bunch of glands in the mesentery, at the lower end of the ileum, is especially involved. The retroperitoneal glands are also swollen.

The *spleen* is invariably enlarged in the early stages of the disease. In 11 of my series it exceeded 20 ounces (600 grams) in weights, in one 900 grams. The tissue is soft, even diffluent. Infarction is not infrequent. Rupture may occur spontaneously or as a result of injury. In the Munich autopsies there were 5 instances of rupture of the spleen, one of which resulted from a gangrenous abscess.

The *bone-marrow* shows changes very similar to those in the lymphoid tissues, and there may be foci of necrosis (Longcope).

The *liver* shows signs of parenchymatous degeneration. Early in the disease it is hyperæmic, and in a majority of instances it is swollen, somewhat pale, on section turbid, and microscopically the cells are very granular and loaded with fat. Nodular areas (miscroscopic) occur in many cases, as described by Hanford. Reed, in Welch's laboratory, could not determine any relation between the groups of bacilli and these areas (Studies II). Some of the nodules are lymphoid, others are necrotic. In 12 of the Munich autopsies liver abscess was found, and in 3, acute yellow atrophy. In 3 of this series liver abscess occurred. Pylephlebitis may follow abscess of the mesentery or perforation of the appendix. Affections of the gall-bladder are not uncommon, and are fully described under the clinical features.

KIDNEYS.—Cloudy swelling, with granular degeneration of the cells of the convoluted tubules, less commonly an acute nephritis, may be present. Rayer, Wagner, and others described the occurrence of numerous small areas infiltrated with round cells, which may have the appearance of lymphomata, or may pass on to softening and suppuration, producing the so-called *miliary abscesses*, of which there were 7 cases in this series. The typhoid bacilli have been found in these areas. They may also be found in the urine. The kidneys in cases of typhoid bacilluria may show no changes other than cloudy swelling. Diphtheritic inflammation of the pelvis of the kidney may occur. It was present in 3 of my cases, in one of which the tips of the papillæ were also affected. Catarrh of the bladder is not uncommon. Diphtheritic inflammation of this viscus may also occur. Orchitis is occasionally met with.

RESPIRATORY ORGANS.—Ulceration of the larynx occurs in a certain number of cases; in the Munich series it was noted 107 times. It may come on at the same time as the ulceration in the ileum. It occurs in the posterior wall, at the insertion of the cords, at the base of the epiglottis, and on the

Studies published in from the Johns Hopkins Hospital Reports.

Studies at Typhoid Fever, from the Johns Hopkins Hospital Reports.

ary-epiglottidean folds. The cartilages are very apt to become involved. In the later periods ulcers may be present.

Œdema of the glottis was present in 20 of the Munich cases, in 8 of which tracheotomy was performed. Diphtheritis of the pharynx and larynx is not very uncommon. It occurred in a most extensive form in 2 of my cases. Lobar pneumonia may be found early in the disease (see Pneumotyphus), or it may be a late event. Hypostatic congestion and the condition of the lung spoken of as splenization occur. Gangrene of the lung occurred in 40 cases in the Munich series; abscess of the lung in 14; hæmorrhagic infarction in 129. Pleurisy is not a very common event. Fibrinous pleurisy occurred in about 6 per cent. of the Munich cases, and empyema in nearly 2 per cent.

Changes in the Circulatory System.—*Heart Lesions.—Endocarditis,* while not a common complication, is probably more frequent than is generally supposed. It was present without being suspected in 3 out of 105 autopsies in this series, while in 3 other cases of my series the clinical symptoms suggested its presence. The typhoid bacilli have been found in the vegetations. *Pericarditis* was present in 14 cases of the Munich autopsies. *Myocarditis* is not very infrequent. In protracted cases the muscle-fibre is usually soft, flabby, and of a pale yellowish-brown color. The softening may be extreme, though rarely of the grade described by Stokes in typhus fever, in which, when held apex up by the vessels, the organ collapsed over the hand, forming a mushroom-like cap. Microscopically, the fibres may show little or no change, even when the impulse of the heart has been extremely feeble. A granular parenchymatous degeneration is common. Fatty degeneration may be present, particularly in long-standing cases with anæmia. The hyaline change is not common. The segmenting myocarditis, in which the cement substance is softened so that the muscles separate, has also been found, but probably as a post-mortem change.

Lesions of the Blood-vessels.—Changes in the arteries are not infrequent. In 21 of 52 cases in our series, in which there were notes on the state of the aorta, fresh endarteritis was present, and in 13 of 62 cases in which the condition of the coronary arteries was noted similar changes were found (Thayer). Arteritis of a peripheral vessel with thrombus formation is not uncommon. Bacilli have been found in the thrombi. The artery may be blocked by a thrombus of cardiac origin—an embolus—but in the great majority of instances they are autochthonous and due to arteritis, obliterating or partial. Thrombosis in the veins is very much more frequent than in the arteries, but is not such a serious event. It is most frequent in the femoral, and in the left more often than the right. The consequences are fully considered under the *symptoms.*

Nervous System.—There are very few obvious changes met with. Meningitis is extremely rare. It occurred in only 11 of the 2,000 Munich cases. The exudation may be either serous, sero-fibrinous, or purulent, and typhoid bacilli have been isolated. Five cases of serous and one of purulent meningitis occurred in our series (Cole). Optic neuritis, which occurs sometimes in typhoid fever, has not, so far as I know, been described in connection with the meningitis. The anatomical lesion of the aphasia—seen not infrequently in children—is not known, possibly it is an encephalitis. Parenchymatous

changes have been met with in the peripheral nerves, and appear to be not very uncommon, even when there have been no symptoms of neuritis.

The *voluntary muscles* show, in certain instances, the changes described by Zenker, which occur, however, in all long-standing febrile affections, and are not peculiar to typhoid fever. The muscle substance within the sarcolemma undergoes either a granular degeneration or a hyaline transformation. The abdominal muscles, the adductors of the thighs, and the pectorals are most commonly involved. Rupture of a rectus abdominis has been found post mortem. Hæmorrhage may occur. Abscesses may develop in the muscles during convalescence.

Symptoms.—In a disease so complex as typhoid fever it will be well first to give a general description, and then to study more fully the symptoms, complications, and sequelæ according to the individual organs.

General Description.—The period of incubation lasts from "eight to fourteen days, sometimes twenty-three" (Clinical Society), during which there are feelings of lassitude and inaptitude for work. The onset is rarely abrupt. In the 1,500 cases chills occurred at onset in 334, headache in 1,117, anorexia in 825, diarrhœa (without purgation) in 516, epistaxis in 323, abdominal pain in 443, constipation in 249, pain in right iliac fossa in 10. The patient at last takes to his bed, from which event, in a majority of cases, the definite onset ~~of the disease~~ may be dated. During the *first week* there is, in some cases (but by no means in all, as has long been taught), a steady rise in the fever, the evening record rising a degree or a degree and a half higher each day, reaching 103° or 104°. The pulse is not rapid when compared with the temperature, full in volume, but of low tension and often dicrotic; the tongue is coated and white; the abdomen is slightly distended and tender. Unless the fever is high there is no delirium, but the patient complains of headache, and there may be mental confusion at night. The bowels may be constipated, or there may be two or three loose movements daily. Toward the end of the week the spleen becomes enlarged and the rash appears in the form of rose-colored spots, seen first on the skin of the abdomen. Cough and bronchitic symptoms are not uncommon at the outset.

In the *second week,* in cases of moderate severity, the symptoms become aggravated; the fever remains high and the morning remission is slight. The pulse is rapid and loses its dicrotic character. There is no longer headache, but there are mental torpor and dulness. The face looks heavy; the lips are dry; the tongue, in severe cases, becomes dry also. The abdominal symptoms, if present—diarrhœa, tympanites, and tenderness—become aggravated. Death may occur during this week, with pronounced nervous symptoms, or, toward the end of it, from hæmorrhage or perforation. In mild cases the temperature declines, and by the fourteenth day may be normal.

In the *third week,* in cases of moderate severity, the pulse ranges from 110 to 130; the temperature ~~now~~ shows marked morning remissions, and there is a gradual decline in the fever. The loss of flesh is ~~now~~ more noticeable, and the weakness is pronounced. Diarrhœa and meteorism may ~~now~~ occur for the first time. Unfavorable symptoms at this stage are the pulmonary complications, increasing feebleness of the heart, and pronounced delirium with muscular tremor. Special dangers are perforation and hæmorrhage.

average [illegible]

especially in Kant. B. can

With the *fourth week*, in a majority of instances, convalescence begins. The temperature gradually reaches the normal point, the diarrhœa stops, the tongue cleans, and the desire for food returns. In severe cases the fourth and even the fifth week may present an aggravated picture of the third; the patient grows weaker, the pulse is more rapid and feeble, the tongue dry, and the abdomen distended. He lies in a condition of profound stupor, with low muttering delirium and subsultus tendinum, and passes the fæces and urine involuntarily. Failure of the circulation and secondary complications are the chief dangers of this period.

In the *fifth and sixth weeks* protracted cases may still show irregular fever, and convalescence may not set in until after the fortieth day. In this period we meet with relapses in the milder forms or slight recrudescence of the fever. At this time, too, occur many of the complications and sequelæ.

Special Features and Symptoms.—*Mode of Onset.*—As a rule, the symptoms come on insidiously, and the patient is unable to fix definitely the time at which he began to feel ill. The following are the most important deviations from this common course:

(*a*) *Onset with Pronounced, Sometimes Sudden, Nervous Manifestations.*—Headache, of a severe and intractable nature, is by no means an infrequent initial symptom. Again, a severe facial neuralgia may for a few days put the practitioner off his guard. In cases in which the patients have kept about and, as they say, fought the disease, the very first manifestation may be pronounced delirium. Such patients may even leave home and wander about for days. In rare cases the disease sets in with the most intense cerebro-spinal symptoms, simulating meningitis—severe headache, photophobia, retraction of the head, twitching of the muscles, and even convulsions. Occasionally drowsiness, stupor, and signs of basilar meningitis may exist for ten days or more before the characteristic symptoms develop; the onset may be with mania and marked mental symptoms.

(*b*) *With Pronounced Pulmonary Symptoms.*—The initial bronchial catarrh may be of great severity and obscure the other features of the disease. More striking still are those cases in which the disease sets in with a single chill, with pain in the side and all the characteristic features of lobar pneumonia, or of acute pleurisy; or tuberculosis is suspected.

(*c*) *With Intense Gastro-intestinal Symptoms.*—The incessant vomiting and pain may lead to a suspicion of poisoning, or the patient may be sent to the surgical wards for appendicitis.

(*d*) *With symptoms of an acute nephritis,* smoky or bloody urine, with much albumin and tube-casts.

(*e*) *Ambulatory Form.*—Deserving of especial mention are those cases ~~of typhoid fever~~ in which the patient keeps about and attempts to do work, or perhaps takes a long journey to his home. He may come under observation for the first time with a temperature of 104° or 105°, and with the rash well out. Many of these cases run a severe course, and in general hospitals ~~they~~ contribute largely to the ~~total~~ mortality. Finally, there are rare instances in which typhoid is unsuspected until perforation or a profuse hæmorrhage from the bowels occurs.

Facial Aspect.—Early in the disease the cheeks are flushed and the eyes bright. Toward the end of the first week the expression becomes more

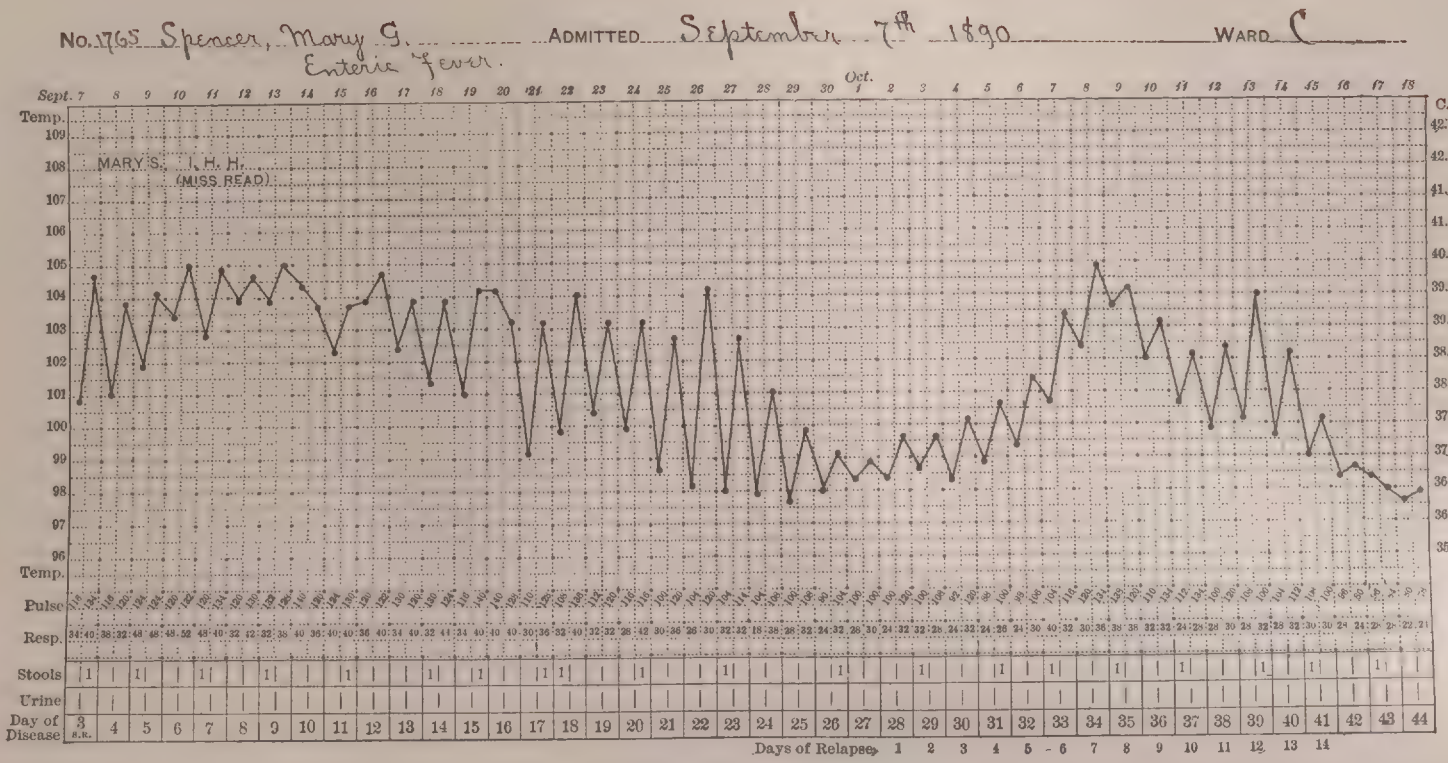

CHART I.—TYPHOID FEVER WITH RELAPSE.

listless, and when the disease is well established the patient has a dull and heavy look. There is never the rapid anæmia of malarial fever, and the color of the lips and cheeks may be retained even to the third week.

FEVER.—(*a*) *Regular Course.* (Chart I.)—In the stage of invasion the fever rises steadily during the first five or six days. The evening temperature is about a degree or a degree and a half higher than the morning remission, so that a temperature of 104° or 105° is not uncommon by the end of the first week. Having reached the fastigium or height, the fever then persists with very slight daily remissions. The fever may be singularly persistent and but little influenced by bathing or other measures. At the end of the second and throughout the third week the temperature becomes more distinctly remittent. The difference between the morning or evening record may be 3° or 4°, and the morning temperature may even be normal. It falls by lysis, and the temperature is not considered normal until the evening record is at 98.4°.

(*b*) *Variations from the typical temperature curve* are common. We do not always see the gradual step-like ascent in the early stage; the patients do not often come under observation at this time. When the disease sets in with a chill, or in children with a convulsion, the temperature may rise at once to 103° or 104°. In many cases defervescence occurs at the end of the second week and the temperature may fall rapidly, reaching the normal within twelve or twenty hours. An inverse type of temperature, high in the morning and low in the evening, is occasionally seen, but has no especial significance.

Sudden falls in the temperature may occur; thus, as shown in Chart II, a drop of 6.4° may follow an intestinal hæmorrhage, and the fall may be very apparent even before the blood has appeared in the stools. Sometimes during the anæmia which follows a severe hæmorrhage from the bowels there are remarkable oscillations in the temperature. Hyperpyrexia is rare. In only 58 of 1,500 cases did the fever rise above 106°. Before death the fever may rise; the highest I have known was 109.5°.

(*c*) *Post-typhoid Variations.*—(1) *Recrudescences.*—After a normal temperature of perhaps five or six days, the fever may rise suddenly to 102° or 103°, without constitutional disturbance, furring of the tongue, or abdominal symptoms. After persisting for from two to four days the temperature falls. Of 1,500 cases, 92 presented these post-typhoid elevations, ~~brief~~ notes of which are given in the Studies on Typhoid Fever. Constipation, errors in diet, or excitement may cause them. These attacks are a frequent source of anxiety to the practitioner. They are ~~very~~ common, and it is not always possible to say upon what they depend. In some cases typhoid or colon bacilli are found in the blood. As a rule, if the rise in temperature is the result of a complication, such as pleurisy or thrombosis, there is an increase in the leucocytes. Naturally one suspects at the outset a relapse, but there is an absence of the step-like ascent, and, as a rule, the fever falls after ~~lasting~~ a few days.

(2) *The Sub-febrile Stage of Convalescence.*—In children, in very nervous patients, and in cases of anæmia, the evening temperature may keep up for weeks after the tongue has cleaned and the appetite has returned. This may usually be disregarded, and is often best treated by allowing the patient to get up, and by stopping the use of the thermometer. Of course, it is important not to overlook any latent complications.

(3) *Hypothermia.*—Low temperatures in typhoid fever are common, following the tubs, or spontaneously in the third and fourth week in the periods of marked remissions, and following hæmorrhage. An interesting form is the persistent hypothermia of convalescence. For ten days or more, particularly in the protracted cases with great emaciation, the temperature may be 96.5° or 97°. It is of no special significance.

(*d*) *The Fever of the Relapse.*—This is a repetition in many instances of the original fever, a gradual ascent and maintenance for a few days at a certain height and then a gradual decline. It is shorter than the original pyrexia, and rarely continues more than two or three weeks. (Chart I.)

(*e*) *Afebrile Typhoid.*—There are cases described in which the chief features of the disease have been present without the existence of fever. They are extremely rare in this country. I have seen a case, afebrile at the thirteenth day, and in which the rose spots and other features persisted till the twenty-eighth day.

(*f*) *Chills* occur (1) sometimes with the fever of onset; (2) occasionally at intervals throughout the course of the disease, and followed by sweats (so-called sudoral form); (3) with the advent of complications, pleurisy, pneumonia, otitis media, phlebitis, etc.; (4) with active antipyretic treatment by the coal-tar remedies; (5) occasionally during the period of defervescence without relation to any complication or sequel, probably due to a septic infection; (6) after the injection of serum; (*e*) according to Herringham, chills may result from constipation. There are cases in which throughout the latter half of the disease chills recur with great severity. (See Chills in Typhoid Fever, Studies II.)

Skin.—The characteristic rash consists of hyperæmic spots, which appear from the seventh to the tenth day, usually at first upon the abdomen. They are slightly raised, flattened papules, which can be felt distinctly, of a rose-red color, disappearing on pressure, and ranging in diameter from 2 to 4 mm. They were present in 93.2 per cent. of the white patients and 20.6 per cent. of the colored. They come out in successive crops, and after persisting for two or three days they disappear, occasionally leaving a brownish stain. The spots may be present upon the back, and not upon the abdomen. The eruption may be very abundant over the whole skin of the trunk, and on the extremities. There were 81 in which they occurred on the arms, 17 on the forearms, 43 on the thighs, legs 15, face 5, hands 3. The cases with very abundant eruption are not necessarily more severe. As already noted, the typhoid bacilli have been found in the spots. Of variations in the rash, frequently the spots are capped by small vesicles. A profuse miliary or sudaminal rash is not uncommon. In 38 cases in my series there were purpuric spots. Three of the cases were true hæmorrhagic typhoid fever. The rash may not appear until the relapse. In 21 cases in our series the rose spots came out after the patient was afebrile.

A branny desquamation is not rare in children, and common in adults after hydrotherapy. Occasionally the skin peels off in large flakes. A yellow color of the palms of the hands and soles of the feet is not uncommon.

Among other skin lesions the following may be mentioned:

Erythema.—It is not very uncommon in the first week of the disease to find a diffuse erythematous blush—E. typhosum. Sometimes the skin may

The attacks usually descend to death in twelve days, with
fevers attended with slight fever for a few days.

typhi. bac. in blood

vaccine or

Incipient
Superficial

The necrosis may begin in the deeper structures

have a peculiar mottled pink and white appearance. E. exudativum, E. nodosum, and urticaria may be present.

Herpes.—Herpes is ~~certainly~~ rare in typhoid fever in comparison with its great frequency in malarial fever and in pneumonia. It was noted in 20 of our 1,500 cases, usually on the lips.

The Tâches bleuâtres—Peliomata—Maculæ ceruleæ.—These are pale-blue or steel-gray spots, subcuticular, from 4 to 10 mm. in diameter, and of irregular outline. They are due to lice (see PEDICULOSIS).

Skin Gangrene.—Areas of superficial gangrene may follow the prolonged use of an ice-bag. In children noma may occur; as reported by McFarland in the Philadelphia epidemic of 1898, there were many cases with multiple areas of gangrene of the skin. The nose, ears, and genitals may be attacked.

Sweats.—At the height of the fever the skin is usually dry. Profuse sweating is rare, but it is not very uncommon to see the abdomen or chest moist with perspiration, particularly in the reaction which follows the bath. Sweats in some instances constitute a striking feature and may occasionally be associated with chilly sensations or actual chills. Jaccoud and others in France have especially described this *sudoral* form of typhoid fever. There may be recurring paroxysms of chill, fever, and sweats (even several in twenty-four hours), and the case may be mistaken for one of malarial fever. Profuse sweats may occur with hæmorrhage or perforation.

Œdema of the skin occurs: (1) As the result of vascular obstruction, most commonly of a vein, as in thrombosis of the femoral vein. (2) In connection with nephritis, very rarely. (3) In association with the anæmia and cachexia. *The hair* falls out after the attack, but complete baldness is rare. I have once seen permanent baldness. The nutrition of the nails suffers, and during and after convalescence tranverse ridges may occur. A peculiar *odor* is exhaled from the skin in some cases. Whether due to a cutaneous exhalation or not, there certainly is a very distinctive smell connected with many patients. Nathan Smith describes it as of a "semi-cadaverous, musty character."

Lineæ atrophicæ.—Lines of atrophy may appear on the skin of the abdomen, lateral aspects of the thighs and about the knees, similar to those seen after pregnancy. They have been attributed to neuritis, and Duckworth has reported a case in which the skin adjacent to them was hyperæsthetic.

Bed-sores are not uncommon in protracted cases, with great emaciation. As a rule, they result from pressure and are seen upon the sacrum, more rarely the ilia, the shoulders, and the heels. These are less common, ~~I think~~, since the introduction of hydrotherapy; scrupulous care and watchfulness do much for their prevention, but it is to be remembered that in cases with profound involvement of the nerve centres acute bed-sores of the back and heels may occur with very slight pressure, and with astonishing rapidity.

Boils and superficial abscesses constitute a common and troublesome sequel.

CIRCULATORY SYSTEM.—The *blood* presents important changes. The following statements are based on studies which W. S. Thayer ~~has~~ made in my wards (Studies I and III): During the first two weeks there may be little or no change in the blood. Profuse sweats or copious diarrhœa may, as Hayem has shown, cause the corpuscles—as in the collapse stage of cholera—to rise above normal. In the third week a fall usually takes place in corpuscles and hæmoglobin, and the number may sink rapidly even to 1,300,000

per c. mm., gradually rising to normal during convalescence. When the patient first gets up, there may be a slight fall in the number of corpuscles. The average maximum loss is about 1,000,000 to the c. mm.

The amount of hæmoglobin is always reduced, and usually in a greater relative proportion than the ~~number of~~ red corpuscles, and during recovery the normal color standard is reached at a later period. Leucopenia is present throughout the course. Cold baths increase temporarily the number of leucocytes in the peripheral circulation. The absence of leucocytosis may be at times of ~~real diagnostic~~ value in distinguishing typhoid fever from various septic fevers and acute inflammatory processes. The polymorphonuclear leucocytes are normal in number, while the large mononuclears are relatively increased. When an acute inflammatory process occurs in typhoid fever the leucocytes show an increase in the polynuclear forms, and this may be of great diagnostic moment.

The post-typhoid anæmia may reach an extreme grade. In one of my patients the blood-corpuscles sank to 1,300,000 per c. mm. and the hæmoglobin to about 20 per cent. These severe grades of anæmia are not common in my experience. In the Munich statistics there were 54 cases with general and extreme anæmia. Of changes in the blood plasma very little is known.

The *pulse* in typhoid fever presents no special characters. It is increased in rapidity, but not always in proportion to the height of the fever, and this may be a very special feature in the early stages. There is no acute disease with which, in the early stage, a dicrotic pulse is so frequently associated. Even with high fever the pulse may not be greatly accelerated. As the disease progresses the pulse becomes more rapid, feebler, and small. In 15 per cent. of our cases the pulse rate rose above 140. In the extreme prostration of severe cases it may reach 150 or more, and is a mere undulation—the so-called running pulse. The lowered arterial pressure is manifest in the dusky lividity of the skin and coldness of the hands and feet.

During convalescence the pulse gradually returns to normal, and occasionally becomes very slow. After no other acute fever do we so frequently meet with bradycardia. I have counted the pulse as low as 30, and instances are on record of still fewer beats to the minute. Tachycardia, while less common, may be a very troublesome and persistent feature of convalescence.

Blood Pressure.—~~(This is usually from 115-125 mm. Hg. (Riva-Rocci instrument) in systole. The diastolic pressure has the normal relationship to the systolic, and averages 85-100 mm. Hg.)~~ There is a gradual fall during the course to about 100-110 mm. Hg. at the beginning of apyrexia. In two or three weeks later the pressure has usually returned to normal. Hæmorrhage usually produces a marked fall both in the systolic and diastolic pressure. In some cases of perforation there is a sharp rise in systolic pressure. Tubs and ice sponges usually cause a rise of 10-20 mm. Hg.

The *heart-sounds* may be normal throughout ~~the course~~. In severe cases, the first sound becomes feeble and there is often ~~to be~~ heard, at the apex and along the left sternal margin, a soft systolic murmur, which was present in 22 per cent. of our cases. Absence of the first sound is rare. Gallop rhythm is not uncommon. In the extreme feebleness of the graver forms, the first and second sound become very similar, and the long pause is much shortened (embryocardia).

Bonner has emphasized the frequency of [illegible] in the male veins and suggests that pulmonary embolism of slight extent is not rare as a result.

Of cardiac complications, *pericarditis* is rare and has been met with chiefly in children and in association with pneumonia. It was present in three of my series and occurred in only 14 of the 2,000 Munich post mortems. *Endocarditis* was found post mortem in three cases, and the physical signs suggested its presence in three other cases in the series. *Myocarditis* is more common, and is indicated by a progressive weakening of the heart-sounds and enfeeblement of the action of the organ.

Complications in the Arteries.—Arteritis with thrombus formation occurred in four cases in the series, one in the branches of the middle cerebral, two in the femoral, and one in the brachial. In one case gangrene of the leg followed. I saw a similar case with Roddick, in Montreal, in which obliteration of the left femoral artery occurred on the sixteenth day, and of the vessel on the right side on the twentieth day, with gangrene of both feet. Pain, tenderness, and swelling occur over the artery, with diminution or disappearance of the pulsations and coldness and blueness of the extremity. In two of the cases these symptoms gradually disappeared, and the pulsation returned not only in the peripheral, but in the affected vessels (Thayer). Keen refers to 46 cases of arterial gangrene, of which 8 were bilateral, 19 on the right side, and 19 on the left.

Thrombi in the Veins.—In our series there were 43 instances, distributed in the following veins: femoral 23, popliteal 5, iliac 5, veins of the calf 5, internal saphenous 3, pulmonary artery and common iliac 1, axillary vein 1 (Thayer). I saw one case in the right circumflex iliac vein. Femoral thrombosis is the most common, and almost invariably in the left vessel, due, as Liebermeister suggests, to the fact that the left iliac vein is crossed by the right iliac artery, and the blood flow is not so free. The symptoms of this complication are very definite—the fever may increase or recur. Chills occurred in 11 of all the cases. Pain and swelling at the site are constantly present, and the thrombotic mass can be felt, not always at first, nor is it well to feel for it. Swelling of the leg follows as a rule, but it is rarely so extreme, and never, I think, so painful as the puerperal phlegmasia alba dolens. In the iliac thrombosis the pain may be severe and lead to the suspicion of perforation, as in one of our cases. Leucocytosis is usually present, in 12 cases it rose above 10,000. Five of the 43 cases died, 2 only as a result of the thrombus; in the case of axillary thrombosis from pulmonary embolism, in one embolism of the inferior cava and right auricle from the dislocation of a piece of thrombus from the left iliac vein. Thayer examined 16 of the patients at varying periods after convalescence, and found in every case more or less disability from the varices and persistent swelling. In some cases, however, the recovery is complete.

Digestive System.—Loss of appetite is early, and, as a rule, the relish for food is not regained until convalescence. Thirst is constant, and should be fully and freely gratified. The *tongue* presents the changes inevitable in a prolonged fever. Early in the disease it is moist, swollen, and coated with a thin white fur, which, as the fever progresses, becomes denser. It may remain moist throughout. In severe cases, particularly those with delirium, the tongue becomes very dry, partly owing to the fact that such patients breathe with the mouth open. It may be covered with a brown or brownish-black fur, or with crusts between which are cracks and fissures. In these cases the teeth

and lips may be covered with a dark brownish matter called *sordes*—a mixture of food, epithelial *débris*, and micro-organisms. By keeping the mouth and tongue clean from the outset, the fissures, which are extremely painful, may be prevented. Acute glossitis occurred in one case at the onset of the relapse. During convalescence the tongue gradually becomes clean, and the fur is thrown off, almost imperceptibly or occasionally in flakes.

The secretion of saliva is often diminished; salivation is rare.

Parotitis was present in 45 of the 2,000 Munich cases. It occurred in 14 cases in my series; of these, 5 died. It is most frequent in the third week in very severe cases. Extensive sloughing may follow in the tissues of the neck. Usually unilateral, and in a majority of cases going on to suppuration, it is regarded as a very fatal complication, but recovery has followed in nine of my cases. It undoubtedly may arise from extension of inflammation along Steno's duct. This is probably not so serious a form as when it arises from metastatic inflammation. In four cases the submaxillary glands were involved alone, in one a cellulitis of the neck extended from the gland and proved fatal. Parotitis may occur after the fever has subsided. A remarkable localized sweating in the parotid region is an occasional sequel of the abscess.

The *pharynx* may be the seat of catarrh or ulceration. Sometimes the fauces are deeply congested. Membranous pharyngitis, a serious and fatal complication, may come on in the third week. Difficulty in swallowing may result from ulcers of the œsophagus, and in one of our cases stricture followed.* Thyroiditis may occur with abscess formation.

The *gastric symptoms* are extremely variable. Nausea and vomiting are not common. There are instances, however, in which vomiting, resisting all measures, is a marked feature from the outset, and may directly cause death from exhaustion. Vomiting does not often occur in the second and third weeks, unless associated with some serious complication. Ulcers have been found in the stomach. Hæmatemesis occurred in 4 of our cases.

Intestinal Symptoms.—Diarrhœa is a very variable symptom, occurring in from 20 to 30 per cent. of the cases. Of 1,500 cases, 516 had diarrhœa before entering, 260 during their stay in hospital. It frequently follows the giving of purgatives and the small percentage in the hospital may be due to the fact that we use no purges ~~or intestinal antiseptics~~. Its absence must not be taken as an indication that the intestinal lesions are of slight extent. I have seen, on several occasions, the most extensive infiltration and ulceration ~~of the Peyer's glands~~ of the small intestine, ~~with~~ the colon filled with solid fæces. The diarrhœa is caused less by the ulcers than by the associated catarrh, and, as in tuberculosis, it is probable that when this is in the large intestine the discharges are more frequent. It is most common toward the end of the first and throughout the second week, but it may not occur until the third or even the fourth week. The number of discharges ranges from 3 to 8 or 10 in the twenty-four hours. They are usually abundant, thin, grayish-yellow, granular, of the consistency and appearance of pea-soup, and resemble very much, as Addison remarked, the normal contents of the small bowel. ~~The reaction~~ is alkaline ~~and the odor offensive~~. On standing, the discharges separate into a thin serous layer, containing albumin and salts,

* Mitchell, Œsophageal Complications in Typhoid Fever (Studies II).

and a lower stratum, consisting of epithelial *débris,* remnants of food, and numerous crystals of triple phosphates. Blood may be in small amount, and only recognized by the microscope. Sloughs of the Peyer's glands occur either as grayish-yellow fragments or occasionally as ovoid masses, an inch or more in length, in which portions of the bowel tissue may be found. The

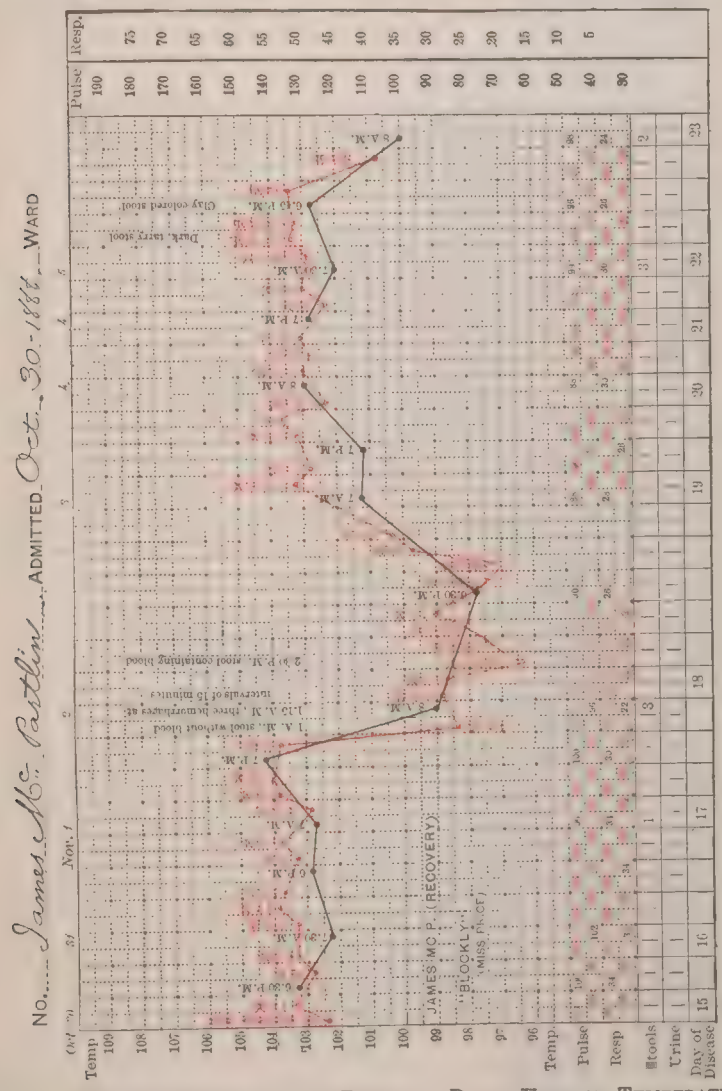

CHART II.—HÆMORRHAGE FROM THE BOWELS. RAPID FALL OF TEMPERATURE.

bacilli are not found in the stools until the end of the first or the middle of the second week. Constipation was present in 51 per cent. of this series.

Hæmorrhage from the bowels is a serious complication, occurring in about 7 per cent. of all cases. It had occurred in 99 of the 2,000 fatal Munich cases. In 1,500 cases treated in my wards hæmorrhage occurred in 118, and in 12 death followed the hæmorrhage. It occurred in 1,641 (7 per cent.) of

23,721 collected cases (McCrae). There may be only a slight trace of blood in the stools, but often it is a profuse, free hæmorrhage. It occurs most commonly between the end of the second and the beginning of the fourth week, the time of the separation of the sloughs. Occasionally, early in the course, it results simply from the intense hyperæmia. It usually comes on without warning. A sensation of sinking or collapse is experienced by the patient, the temperature falls, and may, as in the annexed chart, drop 6° or 7° in a few hours. Fatal collapse may supervene before the blood appears in the stool. Hæmorrhage usually occurs in cases of considerable severity, but Graves and Trousseau held that it was not a very dangerous symptom.

It must not be forgotten that melæna may also be part of a general hæmorrhagic tendency (to be referred to later), in which case it is associated with petechiæ and hæmaturia. There may be a special family predisposition to intestinal hæmorrhages in typhoid fever.

Meteorism, a frequent symptom, is not serious if of moderate grade, but when excessive is usually of ill omen. Owing to defective tone in the walls, in severe cases to their infiltration with serum, gas accumulates in the stomach, small and large bowel, particularly in the last. Pushing up the diaphragm, it interferes very much with the action of the heart and lungs, and may also favor perforation. Gurgling in the right iliac fossa exists in a large proportion of the cases, and indicates simply the presence of gas and fluid fæces in the colon and cæcum.

Abdominal pain and tenderness were present in three-fifths of a series of 500 cases studied with special reference to the point, by T. McCrae. In some it was only present at the onset. Pain occurred during the course in about one-third of the cases. This is due in some instances to conditions apart from the bowel lesions, such as pleurisy, distention of the bladder, and phlebitis. It may be associated with diarrhœa, severe constipation, perisplenitis, or acute abdominal complications. Pain occurs with some cases of hæmorrhage, but is most constantly present with perforation. In a large group no cause could be found for the pain, and if other symptoms be associated the condition may lead to error in diagnosis. Operation for appendicitis has been performed in the early stage of typhoid fever, owing to the combination of pain in the right iliac fossa, fever and constipation.

Perforation.—From one-fourth to one-third of the deaths are due to perforation, and as there were 35,379 deaths from typhoid fever in the United States in the year 1900, this gives between 9,000 and 12,000 deaths from this cause. Among 34,916 collected cases perforation occurred in 3.1 per cent. (McCrae). While it may occur as early as the first week, in the great majority it is at the height of the disease in the third week, and much more frequently in the severe cases, particularly those associated with tympanites, diarrhœa, and hæmorrhage. It may occur, however, in very mild attacks and with great suddenness, when the patient is apparently progressing favorably.

Symptoms of Perforation.—By far the most important single indication is a sudden, sharp pain of increasing severity, often paroxysmal in character. It is rarely absent, except in the small group of cases with profound toxæmia. The situation is most frequent in the hypogastric region and to the right of the middle line. Tenderness on pressure is present in the great majority of cases, usually in the hypogastric and right iliac regions, sometimes diffuse;

Note

sonnet

without opening.

it may only be brought out on deep pressure. As LeConte points out, when the perforation happens to be in contact with the parietal peritoneum the local features on palpation are much more marked than when the perforated ulcer is next to a coil or to the mesentery. There may be early irritability of the bladder, with frequent micturition, and pain extending toward the penis. A third important sign is muscle rigidity, increased tension, and spasm on any attempt to palpate. The temperature may rise for a few hours to fall later or may drop at once. The pulse and respiration rate are usually increased. Following these features in a few hours there is usually a reaction, and then the features of general peritonitis become manifest to a more or less marked degree. Among the general features, the facies of the patient shows changes; there is increased pallor, a pinched expression of the face, and as the symptoms progress and toward the end a marked Hippocratic facies, a dusky suffusion, and the forehead bathed in a clammy perspiration. The temperature rises with the increase of the peritonitis. The pulse quickens, is running and thready, the heart's action becomes progressively more feeble, and there is an increase in the frequency of the respiration. Vomiting is a variable feature; it is present in a majority of the cases. Hiccough is common and may occur early, but more frequently late.

The local abdominal features are often more important than the general, as it is surprising to notice how excellent the condition of a patient may be with perforative peritonitis. Limitation of the respiratory movements is usually present, perhaps confined to the hypogastric area. Increasing distention is the rule, but perforation and peritonitis may occur, it is to be remembered, with an abdomen flat or even scaphoid. Increasing pain on pressure, increasing muscle spasm and tension of the wall are important signs. Percussion may reveal a flat note in the flanks, due to exudate. A friction may be present within a few hours of the onset of the perforation. Obliteration of the liver flatness in the nipple line may be caused by excessive tympany, but rapid obliteration of liver flatness in a flat, or a not much distended abdomen, is a valuable sign. Examination of the rectum may show fullness or tenderness in the pelvis. Advance in the abdominal signs is an important point.

In ~~a majority of all~~ cases there is a rise in the leucocytes, and when present may be a valuable help, but it is not constant. Increase in the blood pressure is not constant.

General peritonitis, without perforation of the bowel, may occur by extension from an ulcer, or by rupture of a softened mesenteric gland, or, as in one ~~recent~~ case in my series, from inflammation of the Fallopian tubes. It was present in 2.2 per cent. of the Munich autopsies.

Perforation is almost invariably fatal. In a few cases healing takes place spontaneously, as is ~~beautifully~~ shown in one of the Pennsylvania Hospital specimens, or the orifice may be closed by a tag of omentum, as in a ~~remarkable~~ case reported by J. Milton Miller. There is a group of cases in which hæmorrhage complicates the perforation and adds to the difficulty in diagnosis. In 7 of our 43 cases hæmorrhage accompanied the perforation; in 3 others the hæmorrhage had occurred some days before.

The diagnosis of perforation, easy enough at times, is not without serious difficulties. The conditions for which it has been mistaken in my wards have been: appendicitis, occurring during the course of the typhoid fever, phlebitis

of the iliac vein with great pain, hæmorrhage, and in one case a local peritonitis without perforation, for which no cause was found. Recovery followed the exploratory operation, which was made in all but one (hæmorrhage case) of the cases. Exploration is justifiable and better than delay in suspicious cases.

Ascites occurs in rare instances (McPhedran).

The spleen is usually enlarged, and the edge was felt below the costal margin in 71.6 per cent. of my cases. Percussion is uncertain, as, owing to distension of the stomach and colon, even the normal area of dulness may not be obtainable. Enlargement is often not marked in elderly patients.

Liver.—Symptoms on the part of this organ are rare.

(*a*) *Jaundice* was present in only 8 cases of my series. Catarrh of the ducts, toxæmia, abscess, and occasionally gall-stones are the usual causes.

(*b*) *Abscess.*—Solitary abscess is exceedingly rare and occurred in but 3 cases in my series. It may occur early in the disease, but most frequently is a sequel. von Eberts has collected 30 cases, in 9 of which the typhoid bacillus was isolated from the pus. In about half the cases the right lobe was affected. Eighteen of the patients recovered. Abscess may follow the intestinal lesion or a complication as parotitis. Suppuratve pylephlebitis may follow perforation of the appendix. Suppurative cholangitis has been described.

(*c*) *Cholecystitis* occurred in 19 cases of the series. Pain in the region of the gall-bladder is the most constant symptom. Tenderness, muscle spasm with rigidity, and a gall-bladder tumor are present in a majority of the cases. Jaundice is inconstant. Leucocytosis usually occurs. With perforation there may be a marked drop in the fever and the onset of signs of peritonitis. In simple cholecystitis the urgency of the symptoms may abate, and recovery follow. Suppuration may occur with infection of the bile passages. Months or years after (~~eighteen years in Hunner's case~~) the bacilli may cause cholecystitis or gall-stones. Typhoid bacilli have been found as a cause of cholecystitis in patients who never had typhoid fever.

(*d*) *Gall-stones.*—Bernheim called attention to the frequency of cholelithiasis after typhoid fever. It is probably associated with the presence of typhoid bacilli in the gall-bladder (see under Gall-Stones).

Pancreas.—Hæmorrhagic pancreatitis has occurred rarely.

Respiratory System.—*Epistaxis,* an early symptom, precedes typhoid fever more commonly than any other febrile affection. It is occasionally profuse and serious.

Laryngitis is not very common. The ulcers and the perichondritis have already been described. Œdema, apart from ulceration, is rare. In the United States the laryngeal complications of typhoid fever seem much less frequent than on the Continent. I have twice seen severe perichondritis; both of the cases recovered, one after the expectoration of large portions of the thyroid cartilage. Keen and Lüning have collected 221 cases of serious surgical complications of the larynx. General emphysema may follow the perforation of an ulcer. Stenosis is a very serious sequence. It would appear that paralysis of the laryngeal muscles is more common than we have supposed. Przedborski (Volkmann's Sammlung, No. 182) systematically examined the larynx in 100 consecutive cases and found 25 with paralysis. The condition is nearly always due to neuritis, sometimes in connection with affections of other nerves.

Jaundice

Slight pyrexia common in the early stages

and may occur during the course of

The stubble is usually scanty.

Bronchitis is one of the most frequent initial symptoms. It is indicated by the presence of sibilant râles. The smaller tubes may be involved, producing urgent cough and even slight cyanosis. Collapse and lobular pneumonia may also occur.

Lobar pneumonia is met with under two conditions:

(*a*) At the outset, the *pneumo-typhus* of the Germans. This occurred in three of our cases. After an indisposition of a day or so, the patient is seized with a chill, has high fever, pain in the side, and within forty-eight hours there are signs of consolidation and the evidences of an ordinary lobar pneumonia. The intestinal symptoms may not occur until toward the end of the first week or later; the pulmonary symptoms persist, crisis does not occur; the aspect of the patient changes, and by the end of the second week the clinical picture is that of typhoid fever. Spots may then be present and doubts as to the nature of the case are solved. In other instances, in the absence of a characteristic eruption, the case remains doubtful, and it is impossible to say whether the disease has been pneumonia, in which the so-called typhoid symptoms have developed, or whether it was typhoid fever with early implication of the lungs. This condition may depend upon an early localization of the typhoid bacillus in the lung.

(*b*) Lobar pneumonia forms a serious and by no means infrequent complication of the second or third week—in 19 of our cases. It was present in over 8 per cent. of the Munich cases. The symptoms are usually not marked. There may be no rusty sputum, and, unless sought for, the condition is frequently overlooked. The etiological agent in these cases is still in dispute. Typhoid bacilli have been isolated from the sputum by Jehle, Rau, and others. They have also been isolated from the consolidated lungs at autopsy, but in such cases the pneumococci may have been originally present, and the typhoid bacilli secondary invaders. In all cases of pneumonia during typhoid fever occurring in the Johns Hopkins Hospital and coming to autopsy, the pneumococcus could be demonstrated in the consolidated lung. Infarction, abscess, and gangrene are occasionally pulmonary complications.

Hypostatic congestion of the lungs and œdema, due to enfeebled circulation, occur in the later periods of the disease. The physical signs are defective resonance at the bases, feeble breath-sounds, and (on deep inspiration) moist râles.

Hæmoptysis may occur. Creagh reports a case in which it caused death.

Pleurisy was present in about 8 per cent. of the Munich autopsies. It occurred in 2 per cent. of my series. It may occur at the outset—pleuro-typhoid—or slowly during convalescence, in which case it is almost always purulent and due to the typhoid bacillus.

Pneumothorax is rare. Hale White has reported two cases, in both of which pleurisy existed. After death, no lesions of the lungs or bronchi were discovered. The condition may be due to straining, or to the rupture of a small pyæmic abscess. It may occur also during convalescence.

Nervous System.—*Cerebro-spinal Form.*—As already noted, the disease may set in with intense and persisting headache, or an aggravated form of neuralgia. There are cases in which the effect of the poison is manifested on the nervous system early and with the greatest intensity. There are headache, photophobia, retraction of the neck, marked twitchings of the muscles, rigidity, and even convulsions. In such cases the diagnosis of meningitis is

invariably made. The cases showing marked *meningeal features* during the course of the disease may be divided into three groups. First, those with symptoms suggestive of meningitis, but without localizing features and without at post mortem the anatomical lesions of meningitis. In every series of cases numerous such examples occur. Secondly, the cases of so-called serous meningitis. There is a localization of typhoid bacilli in the cerebro-spinal fluid and a mild inflammatory reaction, but without suppurative meningitis. Cole has collected thirteen such cases, five of them occurring in our series. Probably more frequent lumbar punctures will show that this occurs not infrequently. Thirdly, true typhoid suppurative meningitis due to *B. typhosus*. Only one such case occurred in our series, and Cole has collected thirteen from the literature. Meningitis in typhoid fever is occasionally due to other organisms, as the tubercle bacillus, or the micrococcus intracellularis. Marked convulsive movements, local or general, with coma and delirium, are seen also in thrombosis of the cerebral veins and sinuses.

Delirium, usually present in very severe cases, is certainly less frequent under a rigid plan of hydrotherapy. It may exist from the outset, but usually does not occur until the second and sometimes not until the third week. It may be slight and only nocturnal. It is, as a rule, a quiet delirium, though there are cases in which the patient is very noisy and constantly tries to get out of bed, and, unless carefully watched, may escape. The patient does not often become maniacal. In heavy drinkers the delirium may have the character of delirium tremens. Even in patients who have no positive delirium, the mental processes are usually dulled and the aspect is listless and apathetic. In severe cases the patient passes into a condition of unconsciousness. The eyes may be open, but he is oblivious to all surrounding circumstances and neither knows nor can indicate his wants. The urine and fæces are passed involuntarily. In this pseudo-wakeful state, or coma vigil, as it is called, the eyes are open and the patient is constantly muttering. The lips and tongue are tremulous; there are twitchings of the fingers and wrists —subsultus tendinum and carphologia. He picks at the bedclothes or grasps at invisible objects. These are among the most serious symptoms of the disease and always indicate danger.

Convulsions in typhoid fever are rare. There were 7 instances in my series. They occur: first, at the onset of the disease, particularly in children; secondly, as a manifestation of the toxæmia; and thirdly, as a result of severe cerebral complications—thrombosis, meningitis, or acute encephalitis. Occasionally in convalescence convulsions may occur from unknown causes. Of the 7 cases 3 died.

Neuritis, which is not uncommon—11 cases in the series—may be local or a widespread affection.

Multiple neuritis comes on usually during convalescence. The legs may be affected, or the four extremities. The cases are often difficult to differentiate from those with subacute poliomyelitis. Recovery is the rule.

Local Neuritis.—This may occur during the height of the fever or after convalescence is established. It may set in with agonizing pain, and with sensitiveness of the affected nerve trunks. The local neuritis may affect the nerves of an arm or of a leg, and involve chiefly the extensors, so that there is wrist-drop or foot-drop. The arm or leg may be much swollen and the

Amer. J. Arch.
July 17.

Bayne-Jones in 1917 formed 33 cases in the literature
Verify total

Phlebitis.

Deafness is common during this event but usually is not permanent.

skin over it erythematous. A curious condition, probably a local neuritis, is that which was first described by Handford as *tender toes*, and which appears to be more common after the bath treatment. The tips and pads of the toes, rarely the pads at their bases, become exquisitely sensitive, so that the patient can not bear the weight of the bedclothes. There is no discoloration and no swelling, and it disappears usually within a week or ten days.

Painful muscles are not uncommon, particularly in the calves. I have reported a series of cases (Studies III). Painful cramps may also occur. In some of the cases of painful legs the condition is a myositis; in others the swelling and pain may be due to thrombosis in the deeper veins.

Poliomyelitis may occur with the symptoms of acute ascending paralysis and prove fatal in a few days. More frequently it is less acute, and causes either a paraplegia or a limited atrophic paralysis of one arm or leg.

Hemiplegia is a rare complication. Smithies (1907) collected 40 cases, in 26 of which aphasia occurred and in 10 the hemiplegia was preceded by convulsions. In 21 cases the paralysis was on the right side. The lesion is usually thrombosis of the arteries, less often a meningo-encephalitis. The aphasia usually disappears.

Aphasia, apart from hemiplegia, occurs rarely and usually in children. The prognosis is good.

True *tetany* occurs sometimes, and has been reported in connection with certain epidemics. It may set in during the height of the disease.

Typhoid Psychoses.—There are three groups of cases: first, an initial delirium, which may be serious, and cause the patient to wander away from his home, or he may even become maniacal; secondly, the psychosis associated directly with the pyrexia and the toxæmia; in a few cases this outlasts the disappearance of the fever for months or even years; and, lastly, the asthenic psychosis of convalescence, more common after typhoid than after any other fever. The prognosis is usually good. Edsall has studied the condition in children, finding 69 cases, of which 43 recovered.

There is a distressing post-typhoid neurasthenia, in which for months or even for years the patient is unable to get into harmony with his surroundings.

Special Senses.—*Eye.*—Conjunctivitis, simple or phlyctenular, sometimes with keratitis and iritis, may develop. Panophthalmitis has been reported in one case in association with hæmorrhage (Finlay). Loss of accommodation may occur, usually in the asthenia of convalescence. Oculo-motor paralysis has been seen, due probably to neuritis. Retinal hæmorrhages may occur alone or in association with other hæmorrhagic features. Double optic neuritis has been described in the course of the fever. It may be independent of meningitis. Atrophy may follow, but these complications are excessively rare. Cataract may follow inflammation of the uveal tract. Other rare complications are thrombosis of the orbital veins and orbital hæmorrhage. (See de Schweinitz in Keen's monograph for full consideration of the subject.)

Ear.—Otitis media is not infrequent, 2.5 per cent. in Hengst's collected cases. We have never found the typhoid bacillus in the discharge. Serious results are rare; only one case of mastoid disease occurred in our series. The otitis may set in with a chill and an aggravation of the fever.

Renal System.—*Retention of urine* is an early symptom and may be the cause of abdominal pain. It may recur throughout the attack. *Suppression*

of urine is rare. The urine is usually diminished at first, has the ordinary febrile characters, and the pigments are increased. Later in the disease it is more abundant and lighter in color.

Polyuria is not very uncommon. While most common during convalescence, the increase may be sudden in the second week at the height of the fever, (as in a case reported by Fussell.) The amount of urine depends very much on the fluid taken. Patients treated by what is known as the washing-out method, in which large quantities of water are taken, may pass enormous amounts, 18 or 19 litres. One of my patients passed as much as 23 litres in one day!

The Diazo-reaction of Ehrlich was found in 894 of 1,467 cases. It may be present previous to the occurrence of the rash, and as late as the twenty-second day. The value of the test is lessened by its occurrence in cases of miliary tuberculosis, in malarial fever, and occasionally in the acute diseases associated with high fever. In cases passing large quantities of urine, the diazo-reaction is very feeble or even absent. The urotoxic coefficient in typhoid fever is high and is said to be increased by the tubs.

Bacilluria caused by the typhoid bacilli occurs in about one-third of the cases. The urine may be turbid from their presence and in the test-tube give a peculiar shimmer. There may be millions of bacilli to the cubic millimetre without pyuria or any symptoms of renal or bladder trouble. The routine administration of urotropin diminishes the occurrence of typhoid bacilluria. The bacilli may be present in the urine for years after the attack (see Gwyn, Studies III). Of 51 cases during the session of 1900-1901 in my clinic, Cole found typhoid bacilli in the urine in 16.

The renal complications in typhoid fever may be thus grouped:

(*a*) Febrile albuminuria is common and of no special significance. It was present in 999 of 1,500 cases, 66 per cent. Tube casts were present in 568 cases, 37.8 per cent. *Hæmoglobinuria* occurred in one case.

(*b*) Acute nephritis at the onset or during the height of the disease—the *nephro-typhus* of the Germans, the *fièvre typhoïd à forme rénale* of the French—may set in, masking in many instances the true nature of the malady. After an indisposition of a few days there may be fever, pain in the back, and the passage of a small amount of bloody urine.

(*c*) Nephritis during convalescence is rare, and is usually associated with anæmia and œdema. Chronic nephritis is a most exceptional sequel.

(*d*) The lymphomatous nephritis, described by E. Wagner, and already referred to in the section on morbid anatomy, produces, as a rule, no symptoms.

(*e*) *Pyuria*, a not uncommon complication, may be associated with the typhoid or the colon bacillus, less often with staphylococci. It disappears during convalescence. It is usually due to a simple catarrh of the bladder, rarely to an intense cystitis.

(*f*) *Post-typhoid Pyelitis.*—One or both kidneys may be involved, either at the height of the disease or during convalescence. There may be blood and pus at first, later pus alone, varying in amount. A severe pyelonephritis may follow. The colon bacillus is often the organism present. *Perinephric abscess* is a rare sequel.

Generative System.—*Orchitis* is occasionally met with. Kinnicutt has collected 53 cases in the literature. It is usually associated with a catarrhal

Infl. of Thyroid [illegible] abscess. - maybe after recovery -

[illegible] / [illegible] per [illegible]

sometimes to pyelitis.

Hypnoidales – self-induced, after a certain stage
absence with 'hypnoid' faculties may be found – viz: case
of Somnambulism

urethritis. Induration or atrophy may occur, and more rarely suppuration. It was present in 4 cases in my series. In 1 case double hydrocele developed suddenly on the nineteenth day (Dunlap). *Prostatitis* occurs rarely.

Acute mastitis, which may go on to suppuration, is a rare complication. It was present in 3 cases of my series during the fever and in one late in convalescence.

Osseous System.—Among the most troublesome of the sequelæ are the *bone lesions* which in a few cases occur at the height of the disease or even earlier. A boy was admitted in the second week of an attack of typhoid fever with acute periostitis of the frontal bone and of one rib. Of 237 cases collected by Keen there was periostitis in 110, necrosis in 85, and caries in 13. They are, I am sure, much more frequent than the figures indicate. Six cases came under my notice in the course of a year, and formed the basis of Parsons' paper (Studies II). The legs are chiefly involved. In Keen's series the tibia was affected in 91 cases, the ribs in 40. The typhoid bone lesion is apt to form what the old writers called a cold abscess. Only a few of the cases are acute. Chronicity, indolence, and a remarkable tendency to recurrence are perhaps the three most striking features. A bony node may be left by the typhoid periostitis.

Arthritis was present in 8 cases of my series. Keen has collected 84 cases from the literature. It may be monarticular or polyarticular. One of the most important points relating to it is the frequency with which spontaneous dislocations occur, particularly of the hip.

Typhoid Spine (Gibney).—During the disease but more often during convalescence, the patient complains of pain in the lumbar and sacral regions, perhaps after a slight jar or shock. Stiffness of the back, pain on movement, sometimes radiating, and tenderness on pressure are the chief features, but there are in addition marked nervous manifestations. There is rigidity and fixation of the spine, usually in the lower part. Kyphosis occurs in some cases. The X-ray plates may show definite bony change. There is usually spondylitis or perispondylitis. The duration is weeks or months, but the outlook is good.

The *muscles* may be the seat of the degeneration already referred to, but it rarely causes any symptoms. Hæmorrhage occasionally occurs into the muscles, and late in protracted cases abscesses may follow. Rupture of a muscle, usually the rectus abdominis, may occur, possibly associated with acute hæmorrhagic myositis.

Post-typhoid Septicæmia and Pyæmia.—In very protracted cases there may recur after defervescence a slight fever (100°-101° F.), with sweats, which is possibly septic. In other cases for two or three weeks there are recurring chills, often of great severity. They are usually of no moment in the absence of signs of complication. (See Studies II and III.)

Typhoid pyæmia is not very uncommon. (*a*) Extensive furunculosis may be associated with irregular fever and leucocytosis. (*b*) Following the fever there may be multiple subcutaneous "cold" abscesses, often with a dark, thin bloody pus. A score or more of these may appear in different parts. Pratt has isolated the bacillus in pure culture from the subcutaneous abscesses. (*c*) A crural thrombus may suppurate and cause a widespread pyæmia. (*d*) In rare instances suppuration of the mesenteric glands, of a splenic infarct, a sloughing parotid bubo, a perinephric or perirectal abscess, acute necrosis

of the bones, or a multiple suppurative arthritis may cause pyæmia. In other cases following bed-sores or a furunculosis there occurs a general infection with pyogenic organisms with a fatal result. In three such cases in our series staphylococci were cultivated from the blood. In one case with many chills late in the disease, and the general condition excellent, typhoid bacilli were cultivated from the blood. The colon bacillus may also be found in blood cultures.

Association of Other Diseases.—Erysipelas is a rare complication, most commonly met with during convalescence. Measles or scarlet fever may develop during the fever or in convalescence. Chicken-pox and noma have been reported in children. Pseudo-membranous inflammations may occur in the pharynx, larynx, or genitals.

Malarial and typhoid fevers may be associated, but a majority of the cases of so-called typho-malarial fever are either remittent malarial fever or true typhoid. It is interesting to note that among 1,500 cases of typhoid fever plasmodia were found in the blood in only 3 cases. (See Lyon, Studies III.) Many of the typhoid fever patients came from malarious regions.

The symptoms of influenza may precede the typhoid fever, or the two diseases may run concurrently. There are cases of chronic influenza which simulate typhoid fever very closely.

Typhoid Fever and Tuberculosis.—(*a*) The diseases may coexist. A person with chronic tuberculosis may contract the fever. Of 105 autopsies in typhoid fever, 7 presented marked tuberculous lesions. Miliary tuberculosis and typhoid fever may occur together. (*b*) Cases of typhoid fever with pulmonary and pleuritic symptoms may suggest tuberculosis at the onset. (*c*) There are five types of tuberculous infection which may simulate typhoid fever: the acute miliary form; tuberculous meningitis; tuberculous peritonitis; the acute toxæmia of certain local lesions; and forms of ordinary pulmonary tuberculosis. And, lastly, pulmonary tuberculosis may follow typhoid. In a large majority of such cases from the onset the disease has been tuberculosis, which has begun with a low fever and features suggestive of typhoid fever.

In epilepsy and in chronic chorea the fits and movements usually cease during an attack, and in typhoid fever in a diabetic subject the sugar may be absent during the height of the disease.

Varieties of Typhoid.—Typhoid fever presents an extremely complex symptomatology. Mary forms have been described, some of which present exaggeration of common symptoms, others modification in the course, others again greater intensity of action of the poison on certain organs. As we have seen, when the nervous system is specially involved, it has been called the cerebro-spinal form; when the kidneys are early and severly affected, nephro-typhoid; when the disease begins with pulmonary symptoms, pneumo-typhoid; with pleurisy, pleuro-typhoid; when the disease is characterized throughout by profuse sweats, the sudoral form of the disease. It is enough to remember that typhoid has no fixed and constant course, that it may set in occasionally with symptoms localized in certain organs, and that many of its symptoms are extremely variable—in one epidemic uniform and text-book-like, in another slight or not met with. This diversified symptomatology has led to many clinical errors, and in the absence of the salutary lessons of morbid anatomy it is not surprising that practitioners have so often been led astray. We may recognize the following varieties:

acuté tuberculoso septicæmia. abscessi in cellulæ tubuli

Sept. 18.

There is usually slight fever
only for a few days.

(*a*) The *mild* and *abortive* forms. Much attention has been paid of late to the milder varieties of typhoid fever—the typhus levissimus of Griesinger. Woodruff of the United States Army, has called special attention to the great danger of neglecting these mild forms, which are often spoken of as mountain fever and malarial fever, "acclimation," "ground," and "miasmatic" fevers. During the prevalence of an epidemic there may be cases of fever so mild that the patient does not go to bed. The onset may be sudden, particularly in children. The general symptoms are slight, the pulse rate not high, the fever rarely above 102°. Rose spots ars usually present, with splenic enlargement. Diarrhœa is rare. The Widal reaction is present in a majority of the patients. There may be a marked tendency to relapse. While infrequent, characteristic complications and sequelæ may give the first positive clue to the nature of the trouble. J. B. Briggs has studied 44 of these mild cases from my clinic, in which the fever lasted 14 days or less. Rose spots were present in 24, and the Widal reaction in 26. There were three relapses. It can not be too forcibly impressed upon the profession that it is just by these mild cases, to which so little attention is paid, that the disease may be kept up in a community.

(*b*) The *grave* form is usually characterized by high fever and pronounced nervous symptoms. In this category come the very severe cases, setting in with pneumonia and nephritis, and with the very intense gastro-intestinal or cerebro-spinal symptoms.

(*c*) The *latent* or *ambulatory* form of typhoid fever which is particularly common in hospital practice. The symptoms are usually slight, and the patient scarcely feels ill enough to go to bed. He has languor, perhaps slight diarrhœa, but keeps about and may even attend to his work throughout the entire attack. In other instances delirium sets in. The worst cases of this form are seen in sailors, who keep up and about, though feeling ill and feverish. When brought to the hospital they often have symptoms of a most severe type of the disease. Hæmorrhage or perforation may be the first marked symptom of this ambulatory type. Sir W. Jenner called attention to the dangers of this form, and particularly to the grave prognosis in the case of persons who have travelled far with the disease in progress.

(*d*) Hæmorrhagic Typhoid Fever.—This is excessively rare. Among Ouskow's 6,513 cases there were 4 fatal cases with general hæmorrhagic features. Only three instances were present in our series. Hæmorrhages may be marked from the outset, but more commonly they come on during the course of the disease. The condition is not ncessarily fatal. Several of those reported by Nicholls from the Royal Victoria Hospital, Montreal, recovered. (See Hamburger, Studies III.)

(*e*) An *afebrile* typhoid fever is recognized by authors. Liebermeister says that the cases were not uncommon at Basel. The patients presented lassitude, depression, headache, furred tongue, loss of appetite, slow pulse, and even the spots and enlarged spleen. I have seen the temperature normal on the sixteenth day, while the spots did not come out until later.

Typhoid Fever in Children.—Griffith collected a series of 325 cases in children under two and a half years; 111 of these were in the first year. Out of a total of 278 cases in which the result was recorded, 142 died. The cases are not very uncommon. The high mortality in Griffith's paper was probably due to the fact that only the more serious cases are reported. The abdominal

symptoms are usually mild; fatal hæmorrhage and perforation are rare. Among sequelæ, aphasia, noma, and bone lesions are stated to be more common in children than in adults. Two of our cases were under one year of age.

Typhoid Fever in the Aged.—After the sixtieth year the disease runs a less favorable course, and the mortality is ~~very~~ high. The fever is not so high, but complications are more common, particularly pneumonia and heart-failure.

Typhoid Fever in Pregnancy.—Pregnancy affords no immunity against typhoid. In 1,500 of our cases to September 10, 1904, 438 of which were females, there were 6 cases. Goltdammer noted 26 pregnancies in 600 cases of typhoid fever in the female. It is more commonly seen in the first half of pregnancy. The pregnancy is interrupted in about 65 per cent. of the cases, usually in the second week of the disease. In the obstetrical department of the Johns Hopkins Hospital (J. W. Williams) there ~~have been~~ (to January, 1905) three cases of puerperal infection with bacillus typhosus. One ~~case~~ showed a localized lesion of the chorion, from which ~~cultures~~ were obtained (Little).

Typhoid Fever in the Fetus.—From the ~~recent~~ studies of Fordyce, J. L. Morse, and F. W. Lynch, we may conclude that the typhoid bacillus may pass through the placenta to the child, causing a typhoid septicæmia, without intestinal lesions. Lynch ~~has recently~~ collected 16 such cases. Infection of the fetus does not necessarily follow, but when infected the child dies, either in utero or shortly after birth. The Widal reaction has been obtained with fetal blood. Its presence does not indicate that the child has survived infection in utero, as the agglutinating substances may filter through the placenta. They may also be transmitted to the nursling through the milk, and cause a transient reaction. The reaction could not be obtained with fetal blood from which typhoid bacilli were cultivated (Lynch).

Relapse.—Relapses vary in frequency in different epidemics, and, it would appear, in different places. The percentages of different authors range from 3 ~~per cent.~~ to 15 or 18 per cent. (Immermann). In 1,500 cases there were 172 relapses, 11.4 per cent. Among 28,057 collected cases 8.8 per cent. had a relapse (~~McCrae~~).

We may recognize the ordinary, the intercurrent, and the spurious relapse.

The *ordinary relapse* sets in after complete defervescence. The average duration of the interval ~~in Irvine's cases was a little over~~ five days.

In one of my cases there was complete apyrexia for twenty-three days, followed by a relapse of forty-one days' duration; then apyrexia for forty-two days, followed by a second relapse of two weeks' duration. As a rule, two of the three important symptoms—step-like temperature at onset, roseola, an enlarged spleen—should be present to justify the diagnosis of a relapse. The intestinal symptoms are variable. The onset may be abruptly with a chill, or the temperature may have a typical ascent, ~~as shown in Chart I.~~ The number of relapses ranges from 1 to 5. In a case at the Pennsylvania Hospital in 1904 the disease lasted eleven months and four days, during which there were six relapses. The relapse is usually less severe, of shorter duration and the mortality is low.

The *intercurrent relapse* is common, often most severe, and is responsible for a great many of the most protracted cases. The temperature drops and

were

bacilli

The average period of normal temp. is about 6 days,
to five or six days.

From some cause

Gordonia. Albany Med. Ann. Sept 36. no 9.

abdominal reflex (umbilical) infra)
and upper with thigh - if second. Dimin. 1st on right then left.
+ in any other some abnormal like temp. normal.
some days then back in same order
if persist - absent. Intervening
Thanks speaks for some abd. superficial conditions

—

Ohio Univ Bull no 25. 16.

with wh.

the patient improves; but after remaining between 100° and 102° for a few days, the fever again rises and the patient enters upon another attack, which may be more protracted, and of much greater intensity than the original one.

Spurious relapses are very common. They have already been mentioned as post-typhoid elevations of temperature. They are recrudescences of the fever due to a number of causes. It is not always easy to determine whether a relapse is present, particularly in cases in which the fever persists for only five or seven days without rose-spots and without enlargement of the spleen.

Undoubtedly a reinfection from within, yet of the conditions favoring the occurrence of relapse we as yet know little. Durham has advanced an interesting theory: Every typhoid infection is a complex phenomenon caused by groups of bacilli alike in species but not identical, as shown by their serum reactions. The antitoxin formed in the blood during the primary attack neutralizes only one (or several) groups, the remaining groups still preserving their pathogenic power. Following an error in diet, or some indiscretion, these latter groups may multiply sufficiently to cause a reinfection. Multiple relapses may be similarly explained.

Diagnosis.—There are several points to note. In the first place, typhoid fever is the most common of all continued fevers. Secondly, it is extraordinarily variable in its manifestations. Thirdly, there is no such hybrid malady as typho-malarial fever. Fourthly, errors in diagnosis are inevitable, even under the most favorable conditions.

Data for Diagnosis.—(*a*) *General.*—No single symptom or feature is characteristic. The onset is often suggestive, particularly the occurrence of epistaxis, and (if seen from the start) the ascending fever. The steadiness of the fever for a week or longer after reaching the fastigium is an important point. The irregular remittent character in the third week, and the intermittent features with chills, are common sources of error. While there is nothing characteristic in the pulse, dicrotism is so much more common early in typhoid fever that its presence is always suggestive. The rash is the most valuable single sign, and with the fever usually clinches the diagnosis. The enlarged spleen is of less importance, since it occurs in all febrile conditions, but with the fever and the rash it completes a diagnostic triad. The absence of leucocytosis and the presence of Ehrlich's reaction are valuable accessory signs.

(*b*) *Specific.*—(1) *Isolation of Typhoid Bacilli from the Blood.*—New methods have given better results in this procedure, which is especially useful early in the disease, in doubtful cases and in the acute septic forms. The hypodermic puncture of a vein for the blood causes little or no pain.

(2) *Isolation of Typhoid Bacilli from the Stools.*—Cultures from the stools have proved of diagnostic value. A satisfactory method is that of von Drigalski and Conradi (Zeit. f. Hygiene, Bd. 39), largely used in the campaign against typhoid in Germany, with which those familiar with bacteriologic methods are able to isolate the bacilli in a majority of the cases.

(3) *Isolation of Typhoid Bacilli from the Urine.*—Neumann, Horton-Smith, Richardson, and Gwyn have shown the great frequency of typhoid bacilli in the urine. In some cases they may be obtained before the Widal test is positive. Routine cultures do not offer great difficulties, and may frequently be of diagnostic value.

(4) *Isolation of Typhoid Bacilli from the Rose-spots.*—Neufeld, Cursch-

mann, and Richardson have demonstrated the presence of the bacilli in rose-spots in 3? of 10 cases examined. As the procedure causes considerable discomfort it can not be used as a routine method.

(5) *The Agglutination Test.*—In 1894 Pfeiffer showed that cholera spirilla, when introduced into the peritoneum of an immunized animal, or when mixed with the serum of immunized animals, lose their motion and break up. This "Pfeiffer's phenomenon" was thoroughly studied by Durham and the specificity of the reaction demonstrated. A. S. Grünbaum and Widal made the method available in clinical work.

Macroscopic or Slow Method.—This may be done with living or dead organisms and has the advantage of use away from a laboratory. The diluted serum and organisms are mixed in a tube of small calibre (dilution 1 to 50 or 1 to 100). With a positive reaction there should be complete precipitation leaving a clear fluid above in twenty-four hours.

Microscopic or Rapid Method.—The serum is mixed with a young bouillon culture of the typhoid bacillus, or with a suspension of a young agar culture, in such a manner as to dilute the serum to the required degree. A hanging-drop preparation of the mixture is made, and if the reaction is positive the bacilli will within a given time lose their motility and collect in clumps. Wyatt Johnston introduced the use of dried blood. It is convenient, but does not permit accurate dilutions. The use of glass bulbs to obtain the serum, and small glass pipettes to make accurate dilutions, is of value. As Cabot says, "the test is a quantitative, not a qualitative, one." Both the degree of dilution and the time limit are of importance. A safe standard, and the one in use at the Johns Hopkins Hospital, is a dilution of 1-50 and a time limit of one hour. Cabot's collection of 5,978 cases gives a positive reaction in 97.2 per cent. It may not appear until late in the course or in a relapse. It may be present even twenty or thirty years subsequent to the attack of fever.

While on the whole the serum reaction is of very great value, there are certain difficulties and objections which must be considered. A perfectly characteristic case with hæmorrhages, rose-spots, etc., may give no reaction throughout. In other cases the reaction is much delayed, becoming positive only during convalescence, or even during a relapse. It must be borne in mind that occasionally the reaction is not obtained with low dilutions, while with higher dilutions it is characteristc.

(6) *Ophthalmo-Reaction.*—A solution of one-third to one-half of a milligram of "typho-protein" derived from many different strains of typhoid bacilli is instilled into the conjunctival sac. A typical reaction is marked by deep congestion of the conjunctiva of the lower lid and the caruncle. It reaches its maximum in six hours. A positive reaction is obtained most often during the febrile period, frequently before the agglutination reaction is given. The simplicity of the method and the absence of discomfort are valuable features. A cutaneous method has also been employed.

Common Sources of Error in Diagnosis.—An early and intense localization of the infection in certain organs may give rise to doubt at first.

Cases coming on with severe headache, photophobia, delirium, twitching of the muscles and retraction of the head are almost invariably regarded as *cerebro-spinal meningitis.* Under such circumstances it may for a few days

agglut. test after inoculation. To det. whether typhus or dualistic
(Carbolyse)

determine highest dilution agglut. in wh. marked agglut. occurs
repeat once or twice at intervals e.g. a few days — note whether any
appreciable alteration occurs in the titre of the serum. i.e. whether
agglutinin power has risen or fallen. If a marked rise or fall
has occurred — then alter typhoid vaccine (Is it for 1st 3 weeks
agglut. titre of serum increased. after wh it falls to wkg level)
Davies. Jathos. Apr 22.

The [illegible] of previous protective inoculation may give the reaction

di Baltimore

be impossible to make a satisfactory diagnosis. I have thrice performed autopsies on cases of this kind in which no suspicion of typhoid fever had been present, the intense cerebro-spinal manifestations having dominated the scene. Until the appearance of abdominal symptoms, or the rash, it may be quite impossible to determine the nature of the case. Cerebro-spinal meningitis is, however, a rare disease; typhoid fever a very common one, and the onset with severe nervous symptoms is by no means infrequent. The lumbar puncture is ~~now~~ a great help.

I have already spoken of the misleading pulmonary symptoms, which occasionally occur at the very outset ~~of the disease~~. The bronchitis rarely causes error, though it may be intense and attract the chief attention. More difficult are the cases setting in with chill and followed rapidly by *pneumonia.* I have brought such a case before the class one week as typical pneumonia, and a fortnight later shown the same case as undoubtedly one of typhoid fever. There is less danger of mistaking the pneumonia which occurs at the height of the disease, and yet this is possible, as in a case admitted ~~a few years ago~~ to my wards—a man aged seventy, insensible, with a dry tongue, tremor, ecchymoses upon the wrists and ankles, no rose-spots, enlargement of the spleen, and consolidation of ~~his~~ the right lower lobe. It was very natural, particularly since there was no history, to regard such a case as senile pneumonia with profound constitutional disturbance, but the autopsy showed the characteristic lesions of typhoid fever. Early involvement of the pleura or the kidneys may for a time obscure the diagnosis.

Of diseases with which typhoid fever may be confounded, malaria, certain forms of pyæmia, acute tuberculosis, and tuberculous peritonitis are the most important.

From *malarial fever,* typhoid is, as a rule, readily recognized. There is no such disease as typho-malarial fever—that is, a separate and distinct malady. Typhoid fever and malarial fever may coexist in the same patient. In patients returning from Cuba and Porto Rico during the late war the two conditions were often found together, but in the United States it is excessively rare. The term typho-malarial fever should be abandoned. The autumnal type of malarial fever may present a striking similarity in its early days to typhoid fever. Differentiation may be made only by the blood examination. There may be no chills, the remissions may be extremely slight, there is a history perhaps of *malaise,* weakness, diarrhœa, and sometimes vomiting. The tongue is furred and white, the cheeks flushed, the spleen slightly enlarged, and the temperature continuous, or with very slight remissions. The æstivo-autumnal variety of the malarial parasite may not be present in the circulating blood for several days. Every year we had one or two cases in which the diagnosis was in doubt for a few days.

Pyæmia.—The long-continued fever of obscure, deep-seated suppuration, without chills or sweats, may simulate typhoid. The more chronic cases of ulcerative endocarditis are usually diagnosed typhoid fever. The presence or absence of leucocytosis is an important aid. The Widal reaction and the blood cultures ~~now~~ offer additional and valuable help.

Acute miliary tuberculosis is not infrequently mistaken for typhoid fever. The points in differential diagnosis will be discussed under that disease.

Tuberculous peritonitis in certain of its forms may closely simulate typhoid fever, and will be referred to in another section.

The early abdominal pain, etc., may lead to the diagnosis of appendicitis.

The "disease" described by Brill (a mild form of typhus fever) may be regarded as typhoid fever, but the character of the rash, the absence of the agglutination reaction, negative results of blood cultures and the course are against this. However, the majority of cases are probably diagnosed as typhoid fever.

Prognosis.—(*a*) DEATH-RATE.—The mortality is very variable, ranging in private practice from 5 to 12 and in hospital practice from 7 to 20 per cent. In some large epidemics the death-rate has been very low. In the Maidstone epidemic it was between 7 and 8 per cent. In recent years the mortality from typhoid fever has certainly diminished, and, under the influence of Brand, the reintroduction of hydrotherapy has reduced the death-rate in institutions in a remarkable manner, even as low as 5 or 6 per cent. Of the 1,500 cases treated in my wards, 9.1 per cent died. The mortality in the Spanish-American War was very low—7 per cent.—and may be attributed to the picked set of men and to the care and attention which the patients received.

(*b*) SPECIAL FEATURES IN PROGNOSIS.—Unfavorable symptoms are high fever, toxic symptoms with delirium, meteorism, and hæmorrhage. Perforation renders the outlook hopeless unless operation is done early. Fat subjects stand typhoid fever badly. The mortality in women is greater than in men. The complications and dangers are more serious in the ambulatory form in which the patient has kept about for a week or ten days. Early involvement of the nervous system is a bad indication; and the low, muttering delirium with tremor means a close fight for life. Prognostic signs from the fever alone are deceptive. A temperature above 104° may be well borne for many days if the nervous system is not involved.

(*c*) SUDDEN DEATH.—It is difficult in many cases to explain this most lamentable of accidents in the disease. There are cases in which neither cerebral, renal, nor cardiac changes have been found; there are instances too in which it does not seem likely that there could have been a special localization of the toxins in the pneumogastric centres. McPhedran, in reporting a case of the kind, in which the post-mortem showed no adequate cause of death, suggests that the experiments of McWilliam on sudden cardiac failure probably explain the occurrence of death in certain of the cases in which neither embolism nor uræmia is present. Under conditions of abnormal nutrition there is sometimes induced a state of *delirium cordis,* which may occur spontaneously, or, in the case of animals, on slight irritation of the heart, with the result of extreme irregularity and finally failure of action. Sudden death occurs more frequently in men than in women, according to Dewèvre's statistics, in a proportion of 114 to 26. It may occur at the height of the fever, and, as pointed out by Graves, may also happen during convalescence. There were four cases in my series.

Prophylaxis.—In cities the prevalence of typhoid fever is directly proportionate to the inefficiency of the drainage and the water-supply. With their improvement the mortality has been reduced one-half or even more. Fulton has shown that in the United States, at least, the disease exists to a proportionately greater extent in the country than it does in the city, and that the

The mild endemic form of typhus fever (described by Bell)

fibrocalcific of the ventricles ?

Steady decline in all ages.

infection

or 1-2 cm below

propagation of this disease is in general from the country to the town. In the water-supply of the latter the chances for dilution of the contaminating fluids are so much greater than in the country, where the privy vault is often in such close proximity to the well.

But it is not only through water that the disease is transmitted. Other methods play an important though not so frequent rôle. The bacilli may be carried by milk, oysters, uncooked vegetables, etc. Flies play an important part in the spread of the disease. Many cases undoubtedly arise by direct infection. But through whatever channel the infection occurs, for new cases to arise the virus must be obtained from another patient. ~~It has been demonstrated by Jordan, Russell, Zeit and others that~~ under ordinary circumstances the bacilli do not live and thrive long outside the body. To stamp out typhoid fever requires (1) *the recognition of all cases, including the typhoid carriers* and (2) *the destruction of all typhoid bacilli as they leave the patient.* It is as much a part of the physician's duty to look after these points as to take care of the patient. Mild cases of fever are to be regarded with suspicion.

From the standpoint of prophylaxis, the question practically narrows down to disinfection of the urine, stools, sputum (in the few cases where bacilli are present), and of objects which may accidentally be contaminated by these excretions. The nurse or attendant should be taught to regard every specimen of urine as a pure culture of typhoid bacilli, and to exercise the greatest care in preventing the scattering of drops of urine over the patient, bedding or floor, or over the hands of the attendant.

To disinfect the urine the best solutions are carbolic acid, 1-20, in an amount equal to that of the urine, or bichloride of mercury, 1-1,000, in an amount one-fifteenth that of the fluid to be sterilized. These mixtures with the urine should stand at least two hours. ~~Urotropin~~ causes disappearance of the bacilli from the urine when bacilluria is present, but under no circumstances should its administration permit the disinfection of the urine to be neglected.

For the stools, heat is the most efficient means and can be employed in hospitals by special hoppers in which steam is used. Of solutions, carbolic acid or freshly prepared milk of lime is most useful. The stool should be mixed with at least thrice its volume of these solutions and allowed to stand for several hours.

With hydrotherapy the disinfection of the bath water offers a somewhat difficult problem. E. Babucke found chloride of lime the best substance to use, and that even when the water contains coarse fæcal matter, 250 gm. (one-half pound) of chloride of lime will render the ordinary bath of 200 litres sterile in one-half hour.

If there be any expectoration, the sputum should receive the same care as in tuberculosis. It is best to collect it in small cloths, which may be burned.

All the linen ~~leaving~~ the patient's bed or person should be soaked for two hours in 1-20 carbolic acid solution, and then sent to the laundry, where it should be boiled. All dishes should be boiled before leaving the patient's room.

The nurse should wear a rubber apron when giving tubs or working over a typhoid patient, and this should be washed frequently with a carbolic acid

or bichloride of mercury solution. The nurse should wear rubber gloves when giving tubs, or else soak her hands throughly in 1-1,000 bichloride solution after she has finished.

It is impossible here to deal with all the possible modes of spread of the infection. Keeping in mind that everything leaving the patient should be sterilized whenever there is a chance of its having been contaminated by the discharges, a nurse of ordinary intelligence, even one of the family, can carry out very satisfactory prophylaxis.

Should the typhoid fever patient be isolated? To prevent direct infection of other members of the family a moderate degree of isolation should be carried out, though this need not be absolute as in the exanthemata. The windows should have fly screens in summer. After recovery the room should be disinfected.

An important question is as to the necessity for the isolation of typhoid patients in special wards in hospitals. At present this is not generally done in the United States. When, however, in a hospital with as good sanitary arrangements as the Johns Hopkins possesses, and in which all possible precautions are taken to prevent the infection spreading from patient to patient, 1.81 per cent. of all the cases have been of hospital origin, the advisability of isolation of typhoid fever patients is certainly worth considering. On the other hand, in the general hospital, with students in the wards, the cases are more thoroughly studied, and in the graver complications, as perforation, it is of the greatest advantage to have the early co-operation of the house surgeon.

During the past few years an active campaign has been started in Germany with the object of ultimately stamping out this disease by means of early diagnosis and the institution of rigid measures for preventing the distribution of the infecting agent from the patients so diagnosed. With a corps of assistants Koch fitted up a laboratory in Trier, a locality where the disease had a firm hold. By bacteriological methods he was able to demonstrate that 72 persons were suffering from typhoid infection. So soon as the nature of a case was established, isolation and vigorous disinfection were practiced. The result was that within three months no more typhoid bacilli were discoverable, the patients were cured, no fresh cases arose, and, so far as that group of villages was concerned, typhoid was exterminated.

When epidemics are prevalent the drinking-water and the milk used in families should be boiled. Travellers should drink light wines or mineral water rather than ordinary water or milk. Care should be taken to thoroughly cook oysters which have been fattened or freshened in streams contaminated with sewage.

While in camps it is easy to boil and filter the water, with troops on the march it is a very different matter, and it is impossible to restrain men from relieving their thirst the moment they reach water. Various chemical methods have been recommended—the use of bromine, hypochlorite of lime, permanganate of potassium, and the tablets of sodium bisulphate, none of which are probably very satisfactory.

VACCINATION.—A. E. Wright has introduced a method of vaccination against typhoid. The material used is a bouillon or agar culture of bacilli heated to 53° to 55° C. in order to kill them. Lysol or tricresol is added. For the first inoculation a quantity of the vaccine containing 500 millions of

one running the bacteria
The nurse shows not ~~—~~ does not prepare her
for others.

Protective inoculation should be
given as soon as ~~possible~~ [illegible]

In communities during an epidemic the early recognition of all cases followed by isolation and thorough disinfection are important. Careful search should be made for the source of infection with especial search for carriers in local outbreaks.

the disease is

new methods of water sterilization

Chlorination has proved the most
efficient.

bacteria is employed, and for the second and third inoculations a quantity containing 1,000 millions of bacilli is employed. Three inoculations are given at intervals of ten days. Following inoculation there is a mild local reaction and constitutional symptoms begin within four to six hours. As a sequence of the injection, there is an increase in both the bactericidal and agglutinating powers of the blood. A study of recent results in the British Army shows that typhoid fever is nearly six times more prevalent among the unvaccinated than among those vaccinated (Leishman). In the United States Army the incidence of the disease has been nearly ten times as great among the unvaccinated (Russell). The results in these attending typhoid fever patients have been excellent. The evidence so far points to a persistence of the protective effect for at least two years after inoculation. The value of this procedure has been thoroughly established. All those exposed to infection, especially nurses, should be protected by it.

Treatment.—(*a*) GENERAL MANAGEMENT.—The profession was long in learning that typhoid fever is not a disease to be treated mainly with drugs. Careful nursing and a regulated diet are the essentials in a majority of the cases. The patient should be in a well-ventilated room (or in summer out of doors during the day), strictly confined to bed from the outset, and there remain until convalescence is well established. The bed should be single, not too high, and the mattress should not be too hard. The woven wire bed, with soft hair mattress, upon which are two folds of blanket, combines the two great qualities of a sick-bed, smoothness and elasticity. A rubber cloth should be placed under the sheet. An intelligent nurse should be in charge. When this is impossible, the attending physician should write out specific instructions regarding diet and treatment of the discharges and bed-linen.

(*b*) DIET.—More liberality in diet is now generally practiced, as was advised years ago by Austin Flint and strongly supported by Shattuck, Kinnicutt and others. The patient should be nourished as well as possible and food given with a value of 2,500 to 3,000 calories and containing about 70 grams of protein if conditions permit. The bulk of the food should be liquid and milk or its modifications form the largest part. Milk in any form, cream, ice cream, cocoa, tea or coffee with cream, strained soups, eggs, either the white or the whole egg, raw or soft boiled, gruels and jellies may be given. The milk may be boiled or diluted, or some modification given—peptonised milk, fermented milk, malted milk, buttermilk or whey. Soft food is often permissible, such as milk toast, custard, junket, crackers and milk, bread and butter, and mashed potatoes. It is important to give carbohydrate freely to spare the body proteins, and this is aided by the addition of milk sugar to the diet; a teaspoonful can be given with each feeding of milk. Sugar can also be given freely in lemonade. The food should be chosen for each patient and a routine diet not allowed. In case of digestive disturbance—undigested food in the stools, diarrhœa, meteorism—the diet should be made very simple, buttermilk, whey, peptonised milk or albumin water usually being suitable. The beef extracts, meat juices, and artificially prepared foods are unnecessary, and in private practice among people in moderate circumstances add greatly to the expense of the illness. Water should be given freely at fixed intervals. A good plan is to have a jug of water beside the patient and tubing with a glass mouth-piece, so that he can

drink as much as he wishes. It is desirable to have the patient take at least four litres of water daily and larger amounts are an advantage. The water causes polyuria, and is a sort of internal hydrotherapy by which the toxins may be washed out. Barley water, lemonade, soda water, or iced-tea may be used.

Special care must be given to the mouth, which should be cleaned after each feeding. A mouth wash should be used freely (such as carbolic acid ℥ i, 4 c. c., glycerine ℥ i, 30 c. c., and boric acid, saturated solution, to ℥ x, 300 c. c.)

Alcohol is unnecessary in a great majority of the cases. Of late years I have used it much less freely, but when the heart is feeble and the toxic symptoms are severe, eight to twelve ounces of whisky may be given in the twenty-four hours.

(*c*) HYDROTHERAPY.—The use of water, inside and outside, was no new treatment in fevers at the end of the eighteenth century, when James Currie (a friend of Burns and the editor of his poems) wrote his Medical Reports on the Effects of Water, Cold and Warm, as a Remedy in Fevers and other Diseases. In this country it was used with great effect and recommended strongly by Nathan Smith, of Yale. Since 1861 the value of bathing in fevers has been specially emphasized by the late Dr. Brand, of Stettin.

Hydrotherapy may be carried out in several different ways, of which, in typhoid fever, the most satisfactory are sponging, the wet pack, and the full bath.

(1) *Cold Sponging.*—The water may be tepid, cold, or ice-cold, according to the height of the fever. A thorough sponge-bath should take from fifteen to twenty minutes. The ice-cold sponging is not quite as formidable as the full bath, for which, when there is an insuperable objection in private practice, it is an excellent alternative. But frequently it is difficult to get the friends to appreciate the advantages of the sponging. When such is the case, and in children and delicate persons, it can be made a little less formidable by sponging limb by limb and then the back and abdomen.

(2) The *cold pack* is not so generally useful in typhoid fever, but in cases with very pronounced nervous symptoms, if the tub is not available, the patient may be wrapped in a sheet wrung out of water at 60° or 65°, and then cold water sprinkled over him with an ordinary watering-pot.

(3) *The Bath.*—The tub should be long enough so that the patient can be completely covered except his head. Our rule for some years has been to give a bath every third hour when the temperature was above 102.5°. The patient remains in the tub for fifteen or twenty minutes, is taken out, wrapped in a dry sheet, and covered with a blanket. While in the tub the limbs and trunk are rubbed thoroughly, either with the hand or with a suitable rubber. It is well to give the first one or two baths at a temperature of 80° to 85°. There is no routine temperature and that between 70° and 85° which suits best is chosen. It is important to see that the canvas supports are properly arranged, and that the rubber pillow is comfortable for the patient's head. The first bath should not be given at night, and it should be superintended by the physician. The amount of complaint made by the patient is largely dependent upon the skill and care with which the baths are given. Food is usually given, sometimes a stimulant, after the bath. The blueness and shiv-

4 to 6

Sca sub.

Gay has reported excellent results from the use of sensitized typhoid
vaccine in
vaccine sediment. His initial dose is 1/50 mg. corresponding to
150 million bacteria. A reduced reaction should be produced

Vaccines.

Lancet. 5.11.15 15.

Brit. Med. 2.50 mills.

5 days bet. Doses. If severe days do not increase. If symp. recur

ering, which often follow the bath, are not serious features. The rectal temperature is taken immediately after the bath, and again three-quarters of an hour later. Contra-indications are peritonitis, hæmorrhage, phlebitis, severe abdominal pain, and great prostration.

The good effects of the baths are: (i) The influence on the nervous system; delirium lessens, tremor diminishes and toxic features are less marked. (ii) Increased excretion of toxins by the kidney. (iii) The tonic effect on the circulation; the heart rate falls, the pulse becomes smaller and harder, and the blood pressure rises. Vaso-motor paresis is lessened. (iv) With hydrotherapy the initial bronchitis is benefitted, and there is less chance of passive congestion of the bases of the lungs. (v) The liability to bed-sores is diminished and the frequent cleansing of the skin is beneficial. The addition of half a pound of alum to the water is an advantage. Should boils occur, one bath-tub should be used for that patient alone. (vi) Reduction of the temperature may occur but is not an important effect. (vii) The mortality is reduced. In general hospitals from six to eight patients in every hundred are saved by this plan of treatment. At the Brisbane Hospital, where F. E. Hare used it so thoroughly, the mortality was reduced from 14.8 per cent. to 7.5. There is a remarkable uniformity in the death-rate of institutions using the method—usually from 6 to 8 per cent. At the Royal Victoria Hospital, Montreal, the rate for six years was 5.1 per cent. At the Johns Hopkins Hospital the mortality among 1,500 cases was 137, or 9.1 per cent.

(*d*) Medicinal Treatment.—There is no specific drug treatment, but it is usually advisable to give urotropin after the second week, twenty to thirty grains (1.3 to 2 gm.) daily. In private practice it may be safer, for the young practitioner especially, to order an acid or a mild fever mixture. The question of medicinal antipyretics is important: they are used far too often and too rashly in typhoid fever. An occasional dose of antifebrin on antipyrin may do no harm, but the daily use of these drugs is most injurious. Quinine in moderate doses is still much employed, but its value is doubtful. In the various antiseptic drugs which have been advised I have no faith. Most of them do no harm, except that in private practice their use has too often diverted the practitioner from more rational and safer courses.

(*e*) Serum Therapy.—Numerous attempts have been made to obtain specific sera, which have been of two varieties, bactericidal and antitoxic. Although strong claims have been made as to the good results obtained by the use of various serums, these have not been generally accepted and thus far no serum of definitely proved value has been obtained. The use of vaccines as a therapeutic measure has not been proved to be of value.

(*f*) Treatment of Special Symptoms.—For severe *toxæmia* water should be given freely by mouth if possible, otherwise by the bowel or by infusion. Hydrotherapy should be used actively, best by tub baths. Whisky is generally indicated, four to ten ounces being given in the twenty-four hours. For headache and delirium an ice-bag or cold compresses should be kept to the head. If the patient is very delirious and restless a dose of morphia hypodermically is the best treatment. Lumbar puncture is also useful, the fluid being allowed to run as long as it flows under pressure. Every delirious patient should be constantly watched. It is important to secure sleep

these patients, for which morphia is most reliable. Hydrotherapy, internal and external, is our greatest aid in the treatment of the nervous conditions. The abdominal *pain* and *tympanites* are best treated with fomentations or turpentine stupes. The latter, if well applied, give great relief. Sir William Jenner used to lay great stress on the advantages of a well-applied turpentine stupe. He directed it to be applied as follows: A flannel roller was placed beneath the patient, and then a double layer of thin flannel, wrung out of very hot water, with a drachm of turpentine mixed with the water, was applied to the abdomen and covered with the ends of the roller. When the stomach is greatly distended the passage of a stomach tube gives relief. When the gas is in the large bowel, a tube may be passed or a turpentine enema given. For tympanites, with a dry tongue, turpentine may be given, ♏ xv (1 c. c.) every three hours, or the oil of cinnamon, ♏ iii-v, every two hours (Caiger). If whey and albumen-water are substituted for milk, the distension lessens. Charcoal, bismuth, β-naphthol, and eserine, $\frac{1}{60}$ gr. hypodermically, may be tried. Opium should not be given.

For the *diarrhœa*, if severe—that is, if there are more than three or four stools daily—a starch and opium enema may be given; or, by the mouth, a combination of bismuth, in large doses, with Dover's powder; or the acid diarrhœa mixture, acetate of lead (gr. ii), dilute acetic acid (♏ xv-xx), and acetate of morphia (gr. $\frac{1}{6}$–$\frac{1}{8}$). The amount of food should be reduced, and whey and albumen-water in small amounts be substituted for the milk. An ice-bag or cold compresses relieve the soreness which sometimes accompanies the diarrhœa.

Constipation is present in many cases, and though I have never seen it do harm, yet it is well every second day to give an ordinary enema. The addition of turpentine (℥ ss, 15 c. c.) is advisable if there is meteorism.

Hæmorrhage.—As absolute rest is essential, the greatest care should be taken in the use of the bed-pan. It is perhaps better to allow the patient to pass the motions into a large pad. Ice may be given, and a light ice-bag placed on the abdomen. The amount of food should be restricted for eight or ten hours. If there is a tendency to collapse, stimulants should be given, and, if necessary, hypodermic injections of camphor. Injection of salt solution beneath the skin or directly into a vein may revive a failing heart, but should only be done in case of emergency and not as a routine measure. Turpentine is warmly recommended by certain authors. Should opium be given? One-fifth of the cases of perforation occur with hæmorrhage, and the opium may obscure the features upon which alone the diagnosis of perforation may be made. Opium also increases any tendency to tympanites. Of late we have abandoned the use of opium and have given the calcium chloride or lactate in doses of gr. xv (1 gm.) every four hours.

Perforation and Peritonitis.—Early diagnosis and early operation mean the saving of one-third of the cases of this heretofore uniformly fatal complication. The aim should be to operate for the perforation, and not to wait until a general peritonitis diminishes by one-half the chances of recovery. An incessant, intelligent watchfulness on the part of the medical attendant and the early co-operation of the surgeon are essentials. Every case of more than ordinary severity should be watched with special reference to this complication. Thorough preparation by early observation, careful notes, and

pituitary extract.

bismuth milk. sodium sulph. sod. salicyl. bismuth.

water.

Horse serum or human serum 10-20 cc.

Transfusion

knowledge of the conditions will help to prevent needless exploration. No case is too desperate; we have had one recovery after three operations. Twenty cases of perforation in my series were operated upon with seven recoveries; in an eighth case the patient died of the toxæmia on the eighth day after the laparotomy. In doubtful cases it is best to operate, as experience shows that patients stand an exploration very well.

Cholecystitis.—A majority of the cases recover, but if the symptoms are very severe and progressive, operation should be advised. For chronic cholecystitis ~~urotropin~~ should be given in large doses and the vaccine treatment employed.

With signs of failure of the *circulation,* hydrotherapy should be carried on actively and strychnine given hypodermically (gr. $\frac{1}{60}$ to $\frac{1}{30}$, 0.001 to 0.003 gm.) every three hours. Saline infusions (500 c. c.) are useful especially if the patient is not taking much water by mouth. ~~Alcohol is generally of value.~~ Digitalis may be given as the tincture (m~~xv~~, 1 c. c.) or digitaline (gr. $\frac{1}{30}$, 0.002 gm.) intramuscularly. For collapse, camphor (gr. ii, 0.13 gm.) ~~or ether hypodermically~~ should be given. The bath treatment is the best preventive of circulatory failure. For *phlebitis* the limb should be kept absolutely at rest and wrapped in raw cotton. The application of a sedative lotion may relieve pain.

Bacilluria.—When bacilli are present, as demonstrated by cultures or shown by the microscope, urotropin may be given in ten-grain doses and kept up, if necessary, for several weeks. A patient should not be discharged with bacilli in his urine.

For *orchitis, mastitis, parotitis,* etc., an ice-bag should be applied. Incision and drainage are advisable on the first signs of suppuration.

In protracted cases very special care should be taken to guard against *bed-sores.* Absolute cleanliness and careful drying of the parts after an evacuation should be enjoined. Pressure should be avoided by the use of rubber rings. The patient should be turned from side to side and propped with pillows, and the back ~~can then be~~ sponged with alcohol.

Bone Lesions.—The use of a typhoid vaccine is well worthy of trial. Typhoid periostitis does not always go on to suppuration, though, as a rule, it requires operation. This should be done very thoroughly and the diseased parts completely removed, as otherwise recurrence is inevitable. For *typhoid spine* fixation by a plaster jacket or some form of apparatus is advisable. Trauma should be guarded against. In the milder cases active counter-irritation is useful. If pain is severe, large doses of sedatives are necessary.

(*g*) The Management of Convalescence.—Convalescents from typhoid fever frequently cause greater anxiety than patients in the attack. The question of food has to be met at once, as the patient acquires a ravenous appetite and clamors for a fuller diet. My custom has been not to allow solid food until the temperature has been normal for ten days. This is, I think, a safe rule, leaning perhaps to the side of extreme caution; but, after all, with the many soft foods, the patient can take a fairly varied diet. Many leading practitioners allow solid food to a patient so soon as he desires it. I had a lesson in this matter which I have never forgotten. A young lad in the Montreal General Hospital, in whose case I was much interested, passed through a tolerably sharp attack of typhoid fever. Two weeks after the even-

ing temperature had been normal, and only a day or two before his intended discharge he ate several mutton chops, and within twenty-four hours was in a state of collapse from perforation. A small transverse rent was found at the bottom of an ulcer which was in process of healing. It is not easy to say why solid food, particularly meats, should disagree, but in so many instances an indiscretion in diet is followed by slight fever, the so-called *febris carnis,* that it is in the best interests of the patient to restrict the diet for some time after the fever has fallen. Whether an error in diet may cause relapse is doubtful. The patient may be allowed to sit up for a short time about the end of the first week of convalescence, and the period may be prolonged with a gradual return of strength. He should move about slowly, and when the weather is favorable should be in the open air as much as possible. He should be guarded at this period against all unnecessary excitement. Emotional disturbance not infrequently is the cause of recrudescence of the fever. Constipation is not uncommon in convalescence and is best treated by enemata. A protracted diarrhœa, which is usually due to ulceration in the colon, may retard recovery. In such cases the diet should be restricted to milk and the patient confined to bed; large doses of bismuth and astringent injections will prove useful. The recrudescence of the fever does not require special measures. The treatment of the relapse is essentially that of the original attack.

Post-typhoid insanity requires the judicious care of an expert. The cases usually recover. The swollen leg after phlebitis is a source of great worry. A bandage or a well-fitting elastic stocking should be worn during the day. The outlook depends on the completeness with which the collateral circulation is established. In a good many cases there is permanent disability.

The *post-typhoid neuritis,* a cause of much alarm and distress, usually gets well, though it may take months, or even a couple of years, before the paralysis disappears. After the subsidence of the acute symptoms systematic massage of the paralyzed and atrophic muscles is the ~~most satisfactory~~ treatment.

Typhoid Carriers.—Treatment of these is difficult. Urotropin should be given persistently and in large doses. Drainage of the gall bladder has been successful in some cases. The employment of an autogenous vaccine offers the best chance of success. Doses increasing from 25 to 1,000 or 1,500 million bacilli are given at intervals of 10 days.

Lastly, no patient should be discharged from observation until we are certain that he can not infect others.

II. COLON BACILLUS INFECTIONS

The colon bacillus, or more properly speaking the group of colon bacilli, in their biological and pathological peculiarities are closely related to the organisms of the typhoid group. Normal inhabitants of the intestines, where in all probability they serve a useful function, the *bacillus coli communis* may be taken as the typical member of the group. The ærogenic, the food-poisoning, the paratyphoid and the dysenteric groups must be excluded. There are great difficulties in determining the extent of the lesions caused by this organism, which varies extraordinarily in virulence. To it has been

Carbuncle — mixed — cancer fungus

brain

Thymal
chancre

(3). Secondary infection in other diseases, e.g. typhoid fever

Pyelonephritis (Colon B.) - Haematogenous infection most common - (e.g. after gonococcal blood culture) - B. excreted by kidneys - Sometimes syphilis - urinary tubule is damaged. So-called pyelonephritis. Kidneys usually return to normal in 10-14 days - so " becomes syphilis as it becomes more chronic -

natural immunity established in some - agglutinins found - Sheep vaccine not helpful - because toxin rather than mucous - than of - vaccine. prev. inoculation tried before operation - prep. diff. because of - many strains of B. coli -

any immunity is probably temporary -

(3) In as a secondary infection in other diseases, for example typhoid

attributed a host of maladies from appendicitis to old age, but more conservative pathologists limit very much its pathogenic scope. It is not easy to separate the effects of the *B. coli* from those of other organisms with which it is so often associated. The needful bacteriological distinction must be considered in connection with agglutination and opsonic tests.

Recognized infections may be classed as follows:

A. General Hæmic Infections.—There are several groups of cases:

(*a*) *Terminal Infections.*—After death the colon bacillus swarms in the body, invading the blood and contaminating all parts. In protracted illnesses, in acute intestinal and peritoneal affections it may be present in the blood some time before death and may be responsible for the terminal fever.

(*b*) Cases running a course resembling typhoid fever. ~~To this group much attention has been paid of late and there are now some 50 cases in the literature (Draper).~~

(*c*) Cases of general infection with secondary abscesses.

B. Sub-infections.—Adami ~~has~~ suggested that a large number of chronic diseases have their origin in a mild, continuous infection with *B. coli* and he has brought forward evidence to show that such affections as anæmia and cirrhosis of the liver may be due to it. Metchnikoff induced the lesions of early cirrhosis and of arterio-sclerosis by administering the products of the growth of the *B. coli.* The question is under discussion and is far from settled.

C. Local Infections.—Here we are on safer ground and we know of three definite lesions produced by the organism.

(*a*) *Peritonitis.*—In perforation of the bowel, in strangulated hernia, in obstruction in various types of ulcer, the associated peritonitis may be due to *B. coli.*

(*b*) *Cholecystitis* and *cholangitis,* either of the simple catarrhal type or suppurative, may be caused by it.

(*c*) *Infection of the Urinary Tract.*—The bladder and the pelves of the kidneys are chiefly affected. There are three possible channels of infection—by the ureter, the blood stream, and the lymphatics. The first route is probably the common one in women and children; but lymphatic infection from the bowel plays a very important role in a great many of the cases. Bowel troubles have been present, constipation or diarrhœa. It has been shown experimentally that with very slight abrasion of the mucosa of the colon the bacilli may enter the lymphatics. An interesting point is the relative frequency of involvement of the right kidney; Franke states that the cæcum and ascending colon are connected by a train of lymphatics with the right kidney, an anatomical communication not present with the left. Clinically there are ~~three~~ important groups of cases. (1) In children, in whom it seems by no means uncommon. In Jeffrey's study of 60 cases at the Hospital for Sick Children a large proportion occurred in females (53). Death followed in 9 cases. (2) In connection with pregnancy. The cases are common and important and may occur at any time during pregnancy or follow delivery. The pelvis of the right kidney is most often attacked. (3) The group of cases in adults, men and women, in whom, without any obvious cause, and in the majority of cases that I have seen, without any previous intestinal trouble, acute pyelitis or pyelocystitis comes on. The infection is obstinate and very difficult to treat, ~~even with vaccines~~. An interesting and distressing sequel

is a chronic arthritis. In one instance the condition was very similar to that of a gonorrhœal synovitis and periarthritis. The clinical picture presents nothing peculiar. (4) Intestines. To the *bacillus coli* almost all the diseases of the bowels from ulcers of the duodenum to appendicitis have been attributed. Ulcers of the stomach and of the duodenum have been produced by feeding cultures of *B. coli* to dogs, and from the peptic ulcers of very young infants Helmholz has isolated the organism in pure culture. The not infrequent association of appendicitis and peptic ulcer has been attributed to toxins from the appendix and large bowel. There is great difficulty in determining the precise etiological relationship of *B. coli* to the various lesions of the gastro-intestinal tract. (5) Other local infections with which the *colon bacillus* has been associated are acute meningitis, abscess of the brain, endocarditis, and suppuration in various parts. Only in a small proportion of these cases has the association been demonstrated by cultural and biological tests.

III. THE PYOGENIC INFECTIONS

(*Septicæmia, Sapræmia, Pyæmia*)

Definition.—A group of non-specific diseases, induced by a number of micro-organisms, of which the pyogenic cocci are the most important, characterized by fever, chills, leucocytosis, often a profound intoxication and sometimes by foci of suppuration.

A hard-and-fast line can not be drawn between an infection and an intoxication, but agents of infection alone are capable of reproduction, whereas those of intoxication are chemical poisons, some of which are produced by the agency of bacteria, or by vegetable and animal cells. Infectious diseases which are communicated directly from one person to another are termed contagious, and the infecting agent is sometimes spoken of as a contagium. "Whether or not an infectious disease is contagious in the ordinary sense depends upon the nature of the infectious agent, and especially upon the manner of its elimination from and reception by the body. Most but not all contagious diseases are infectious. Scabies is a contagious disease, but it is not infectious" (Welch).

There are three chief clinical types of pyogenic infection:

1. LOCAL INFECTIONS WITH THE DEVELOPMENT OF TOXINS

This is the common mode of invasion of many of the infectious diseases. Tetanus, diphtheria, erysipelas, and ~~pneumonia~~ are diseases which have sites of local infection in which the pathogenic organisms develop; but the constitutional effects are caused by the absorption of the poisonous products. ~~The~~ diphtheria toxin produces all the general symptoms, the tetanus toxin every feature of the disease without the presence of their respective bacilli. Certain of the symptoms following the absorption of ~~the~~ toxins are general to all; others are special and peculiar, according to the organism which produces them. A chill, fever, general malaise, prostration, rapid pulse, restlessness, and headache are the most frequent. With but few exceptions the febrile disturbance is the most common feature. The most serious effects are upon the ner-

add. Local infection in newly married women

secondary infections e.g. with typhoid

(4). In ~~newly married~~ women (some after marriage) there may be a cystitis and typhoid bacillus infection with the colon bacillus. It is important not to mistake this for a gonococcus infection.

Treatment. In the general infection is much the same as in typhoid fever. In the infection of the urinary tract the diet should be simple, and alkalies should be given very freely. Hexamine should be given in large doses. The use of vaccines is worth a trial but is often disappointing.

Certain. Staphylococci tend to localize in the tissues from which they are isolated.

These cocci are not so significant as streptococci

vous system and upon the circulation, and the gravity of the symptoms on the part of these organs is to some extent a measure of the intensity of the intoxication. The organisms of certain local infections produce poisons which have special actions; thus, the diphtheria toxin, besides having the effects already referred to, is especially prone to attack the nervous system and to cause peripheral neuritis. The tetanus toxin has a specific action on the motor neurones.

2. SEPTICÆMIA

Formerly, and in a surgical sense, the term "septicæmia" was used to designate the invasion of the blood and tissues of the body by the organisms of suppuration, but in the medical sense the term may be applied to any condition in which, with or without a local site of infection, there is microbic invasion of the blood and tissues, but without metastatic foci of suppuration. Owing to the great development of bacteria in the blood, and in order to separate it sharply from local infectious processes with toxic invasion of the body, it is proposed to call this condition bacteræmia; toxæmia denotes the latter state.

(a) Progressive Septicæmia from Local Infection.—The common streptococcus and staphylococcus infection is, as a rule, first local, and the toxins alone pass into the blood. In other instances the cocci appear in the blood and throughout the tissues, causing a septicæmia which intensifies greatly the severity of the case. Other infections in which the bacterial invasion, local at first, may become general are pneumonia, anthrax, gonorrhœa, and puerperal fever.

The clinical features of this form are well seen in the cases of puerperal septicæmia or in dissection wounds, in which the course of the infection may be traced along the lymphatics. The symptoms usually set in within twenty-four hours, and rarely later than the third or fourth day. There is a chill or chilliness, with moderate fever at first, which gradually rises and is marked by daily remissions and even intermissions. The pulse is small and compressible, and may reach 120 or higher. Gastro-intestinal disturbances are common, the tongue is red at the margin, and the dorsum is dry and dark. There may be early delirium or marked mental prostration and apathy. As the disease progresses there may be pallor of the face or a yellowish tint. Capillary hæmorrhages are not uncommon.

In streptococcus cases we are beginning to recognize the fact that these infections are not always so serious as we thought. Death may occur within twenty-four hours or be delayed for several days, even for weeks, and recovery may occur. One patient showed streptococci in the blood for six weeks, but ultimately recovered (Cole). On post-mortem examination there may be no gross focal lesions in the viscera, and the seat of infection may present only slight changes. The spleen is enlarged and soft, the blood may be extremely dark in color, and hæmorrhages are common, particularly on the serous surfaces. Neither thrombi nor emboli are found. Certain clinical features separate the streptococcus from the staphylococcus infection, chiefly the absence of delirium, a rather abnormal mental acuteness, and the presence of a greater degree of anæmia.

Many instances of septicæmia are combined infections; thus, in diphtheria streptococcus septicæmia is a common, and the most serious, event. The local disease and the symptoms produced by absorption of the toxins dominate the clinical picture; but the features are usually much aggravated by the systemic invasion. A similar infection may occur in typhoid fever and in tuberculosis, and may obscure the typical picture. These secondary septicæmias are caused most frequently by the streptococcus, but may result from the invasion of other bacteria.

(b) **General Septicæmia without Recognizable Local Infection.**—*Cryptogenetic Septicæmias.*—This is a group of very great interest to the physician, the full importance of which we are only now beginning to recognize.

The subjects when attacked may be in perfect health; more commonly they are already weakened by acute or chronic illness. The pathogenic organisms are varied. *Streptococcus pyogenes* is the most common; the forms of staphylococcus more rare. Other occasional causal agents are *Micrococcus lanceolatus* (pneumococcus), *Bacillus proteus, Bacillus pyocyaneus* and *Bacillus influenzæ.* Between May 1, 1892, and June 1, 1895, there were examined in the post-mortem room from my wards 21 cases of general infection, of which 13 were due to *Streptococcus pyogenes,* 2 to *Staphylococcus pyogenes,* and 6 to the pneumococcus. In 19 of these cases the patients were already the subjects of some other malady, which was aggravated, or in most instances terminated, by the general septicæmia. The symptoms vary somewhat with the character of the micro-organisms. In the streptococcus cases there may be chills with high, irregular fever, and a more characteristic *septic* state than in the pneumococcus infection.

These cases come correctly under the term "cryptogenetic septicæmia" as employed by Leube, inasmuch as the local focus of infection is not evident during life and may not be found after death. Although most of these cases are terminal infections, yet it is well to bear in mind that there are instances of this type of affection coming on in apparently healthy persons. The fever may be extremely irregular, characteristically septic, and persist for many weeks. Foci of suppuration may not develop, and may not be found even at autopsy. I have on several occasions met with cases of an intermittent pyrexia persisting for weeks, in which it seemed impossible to give any explanation of the phenomena, and some which ultimately recovered, and in which tuberculosis and malaria could be almost positively excluded. These cases require to be carefully studied bacteriologically. Dreschfeld has described them as idiopathic intermittent fever of pyæmic character. Local symptoms may be absent, though in three of his cases there was enlargement of the liver, and in two the condition was a diffuse suppurative hepatitis. The pyocyanic disease, or cyano-pyæmia, is an extremely interesting form of infection with *Bacillus pyocyaneus,* of which a large number of cases have been reported.

3. SEPTICO-PYÆMIA

The pathogenic micro-organisms which invade the blood and tissues may settle in certain foci and there cause suppuration. When multiple abscesses are thus produced in connection with a general infection, the condition is known as pyæmia or, perhaps better, septico-pyæmia. There are no specific

Peri-Dental appearances basicus - Streptococci & viridans group as constantly present.

may be
visible

organisms of suppuration, and the condition of pyæmia may be produced by organisms other than the streptococci and staphylococci, though these are the most common. Other forms which may invade the system and cause foci of suppuration are *Micrococcus lanceolatus,* the gonococcus, *Bacillus coli, Bacillus typhosus, Bacillus proteus, Bacillus pyocyaneus, Bacillus influenzæ.* In a large proportion of all cases of pyæmia there is a focus of infection, either a suppurating external wound, an osteomyelitis, a gonorrhœa, an otitis media, an empyema, or an area of suppuration in a lymph-gland or about the appendix. In a large majority of all these cases the common pus cocci are present.

In a suppurating wound, for example, the pus organisms induce hyaline necrosis in the smaller vessels with the production of thrombi and purulent phlebitis. The entrance of pus organisms in small numbers into the blood does not necessarily produce pyæmia. Commonly the transmission to various parts from the local focus takes place by the fragments of thrombi which pass as emboli to different parts, where, if the conditions are favorable, the pus organisms excite suppuration. A thrombus which is not septic or contaminated, when dislodged and impacted in a distant vessel, produces at most only a simple infarction; but, coming from an infected source and containing pus microbes, an independent centre of infection is established wherever the embolus may lodge. These independent suppurative centres in pyæmia, known as *embolic* or *metastatic abscesses,* have the following distribution:

(*a*) In external wounds, in osteo-myelitis, and in acute phlegmon of the skin, the embolic particles very frequently excite suppuration in the lungs, producing the well-known wedge-shaped pyæmic infarcts; from these, or rarely by paradoxical embolism, or direct passage of bacteria or minute emboli through the pulmonary capillaries, metastatic foci of inflammation may occur in other parts.

(*b*) Suppurative foci in the territory of the portal system, particularly in the intestines, produce metastatic abscesses in the liver with or without suppurative pylephlebitis.

Endocarditis is an event which is very liable to occur in all forms of septicæmia, and modifies materially the character of the clinical features. Streptococci and staphylococci are the most common organisms present in the vegetations, but pneumococci, gonoccocci, tubercle bacilli, typhoid bacilli, anthrax bacilli, and other forms have been isolated. The vegetations which grow at the site of the valve lesion become covered with thrombi, particles of which may be dislodged and carried as emboli to different parts of the body, causing multiple abscesses or infarcts.

Symptoms of Septico-pyæmia.—In a case of wound infection, prior to the onset of the characteristic symptoms, there may be signs of local trouble, and in the case of a discharging wound the pus may change in character. The onset of the disease is marked by a severe rigor, during which the temperature rises to 103° or 104° and is followed by a profuse sweat. These chills are repeated at intervals, either daily or every other day. In the intervals there may be slight pyrexia. The constitutional disturbance is marked and there are loss of appetite, nausea, and vomiting, and, as the disease progresses, rapid emaciation. Transient erythema is not uncommon. Local symptoms usually occur. If the lungs become involved there are dyspnœa and cough. The physical signs may be slight. Involvement of the pleura and pericardium is

common. The anæmia, often profound, causes great pallor of the skin, which later may be bile-tinged. The spleen is enlarged, and there may be intense pain in the side, pointing to perisplenitis from embolism. Usually in the rapid cases a typhoid state supervenes, and the patient dies comatose.

In the chronic cases the disease may be prolonged for months; the chills recur at long intervals, the temperature is irregular, and the condition of the patient varies from month to month. The course is usually slow and progressively downward.

Diagnosis.—Pyæmia is a disease frequently overlooked and often mistaken for other affections.

Cases following a wound, an operation, or parturition are readily recognized. On the other hand, the following conditions may be overlooked:

Osteo-myelitis.—Here the lesion may be limited, the constitutional symptoms severe, and the course of the disease very rapid. The cause of the trouble may be discovered only post mortem.

So, too, acute septico-pyæmia may follow *gonorrhœa* or a *prostatic abscess.*

Cases are sometimes confounded with *typhoid fever,* particularly the more chronic instances, in which there are diarrhœa, great prostration, delirium, and irregular fever. The spleen, too, is often enlarged. The marked leucocytosis is an important differential point.

In some of the instances of *ulcerative endocarditis* the diagnosis is very difficult, particularly in what is known as the typhoid, in contradistinction to the septic, type of this disease. In *acute miliary tuberculosis* the symptoms occasionally resemble those of septicæmia, more commonly those of typhoid fever.

The *post-febrile arthritides,* such as occur after scarlet fever and gonorrhœa, are really instances of mild septic infection. The joints may sometimes suppurate and pyæmia develop. So, also, in *tuberculosis of the kidneys* and *calculous pyelitis* recurring rigors and sweats due to septic infection are common. In some latitudes septic and pyæmic processes are too often confounded with *malaria.* In early tuberculosis, or even when signs of excavation are present in the lungs, and in cases of suppuration in various parts, particularly empyema and abscess of the liver, the diagnosis of malaria is made. The practitioner may take it as a safe rule, to which he will find very few exceptions, that *an intermittent fever which resists quinine is not malaria.*

Other conditions associated with chills which may be mistaken for pyæmia are profound anæmia, certain cases of Hodgkin's disease, the hepatic intermittent fever associated with the lodgment of gall-stones at the orifice of the common duct, rare cases of essential fever in nervous women, and the intermittent fever sometimes seen in rapidly growing cancer.

Treatment.—(*a*) General.—Nourishment should be given as liberally as possible. Water should be forced and it is well to give it by the drop method into the bowel and by infusion if there is any difficulty in taking it by mouth. Hydrotherapy by tub baths is useful. Alcohol is generally indicated, and with severe toxæmia should be given in full doses.

(*b*) Surgical.—In pyæmia, when the pus is accessible, free evacuation and drainage is often the only treatment required. In a case of empyema with weeks of high and irregular fever the day after operation the temperature

cholecystitis infectio arteriae thrombosis

3000 calories, 80 gm. proteins liquids soft food. effect
pancreatin. appet. academic + salutis medicin for sleep.

Serum-

serum- and

~~Autogenous vaccine~~

Nephritis

may be normal, and remain so. In some cases with a local infection Bier's method of hyperæmia has been used with success, but where the focus of manufacture of the poison is accessible the knife should be used. Unfortunately, in only too many cases the focus of infection is not accessible; it then is a septicæmia, and for such cases the bacteriologists have introduced the treatment with vaccines.

(*c*) VACCINE TREATMENT.—By blood cultures or by cultures from the focus of infection the organism is isolated, then a vaccine is prepared, and if Wright's method is followed, the use and dose are regulated by the opsonic index of the patient. "Stock" vaccines may be used, but are not as useful as an autogenous vaccine. In many cases in which the germ cannot be isolated and the condition is one of septic fever the ordinary antistreptococcus serum or one of the polyvalent serums is used. Good results are not infrequently obtained.

(*d*) DRUGS.—There are none which control septic fever. The coal-tar products are of doubtful service. Quinine may be used. The intravenous injection of antiseptic drugs has not been proved to be of value.

4. TERMINAL INFECTIONS

There is truth in the paradoxical statement that persons rarely die of the disease with which they suffer. Secondary, *terminal* infections carry off many incurable cases. Flexner analyzed 255 cases of chronic renal and cardiac disease in which complete bacteriological examinations were made at autopsy. Excluding tuberculous infection, 213 gave positive and 42 negative results. The infections may be local or general. The former are extremely common, and are found in a large proportion of all cases of Bright's disease, arterio-sclerosis, heart disease, cirrhosis of the liver, and other chronic disorders. Affections of the serous membranes (acute pleurisy, pericarditis, or peritonitis), meningitis, and endocarditis are the most frequent lesions. It is perhaps safe to say that the majority of cases of advanced arterio-sclerosis and of Bright's disease succumb to these intercurrent infections. The infective agents are very varied. The streptococcus is the most common, but the pneumococcus, staphylococcus and gonococcus, and the proteus, pyocyaneus, and gas bacillus are also found. It is surprising in how many instances of arterio-sclerosis, of chronic heart disease, of Bright's disease, and particularly of cirrhosis of the liver in Flexner's series the fatal event was determined by an acute tuberculosis of the peritoneum or pleura.

The general terminal infections are somewhat less common. Of 85 cases of chronic renal disease in which Flexner found micro-organisms at autopsy, 38 exhibited general infections; of 48 cases of chronic cardiac disease, in 14 the distribution of bacteria was general. The blood-serum of persons suffering from advanced chronic disease was found by him to be less destructive to the staphylococcus aureus than normal human serum. Other diseases in which general terminal infection may occur are Hodgkin's disease, leukæmia, and chronic tuberculosis.

And, lastly, probably of the same nature is the terminal entero-colitis so frequently met with in chronic disorders.

IV. ERYSIPELAS

Definition.—A special pyogenic infection caused by the *streptococcus erysipelatis,* characterized by inflammation of the skin with fever and toxæmia.

Etiology.—Erysipelas is a widespread affection, endemic in most communities, and at certain seasons epidemic. We are as yet ignorant of the atmospheric or telluric influences which favor the diffusion of the poison.

It is particularly prevalent in the spring of the year. Of 2,012 cases collected by Anders, 1,214 occurred during the first five months of the year. April had the largest number of cases. The affection prevails extensively in old, ill-ventilated hospitals and institutions in which the sanitary conditions are defective. With the improved sanitation of late years the number of cases has materially diminished. It has been observed, however, to break out in new institutions under the most favorable hygienic circumstances. Erysipelas is both contagious and inoculable; but, except under special conditions, the poison is not very virulent and does not seem to act at any great distance. It can be conveyed by a third person. The poison attaches itself to the furniture, bedding, and walls of rooms in which patients have been confined.

The disposition to the disease is widespread, but the susceptibility is specially marked in the case of individuals with wounds or abrasions of any sort. Recently delivered women and persons who have been the subjects of surgical operations are particularly prone to it. A wound, however, is not necessary, and in the so-called idiopathic form, although it may be difficult to say that there was not a slight abrasion about the nose or lips, in very many cases there certainly is no observable external lesion. In some cases the infection apparently spreads through the tissues from the nasal cavity to the skin.

Chronic alcoholism, debility, and Bright's disease are predisposing agents. Certain persons show a special susceptibility to erysipelas, and it may recur in them repeatedly. There are instances, too, of a family predisposition.

The specific agent of the disease is a streptococcus growing in long chains, which is included under the group name *Streptococcus pyogenes,* with which *Streptococcus erysipelatis* appears to be identical. The fever and constitutional symptoms are due in great part to the toxins; the more serious visceral complications are the result of secondary metastatic infection.

Morbid Anatomy.—Erysipelas is a simple inflammation. In its uncomplicated forms there is seen, post mortem, little else than inflammatory œdema. Investigations have shown that the cocci are found chiefly in the lymph-spaces and most abundantly in the zone of spreading inflammation. In the uninvolved tissue beyond the inflamed margin they are to be found in the lymph-vessels, and it is here, according to Metschnikoff and others, that an active warfare goes on between the leucocytes and the cocci (phagocytosis). In more extensive and virulent forms of the disease there is usually suppuration.

Infarcts occur in the lungs, spleen, and kidneys, and there may be the general evidences of pyæmic infection. Some of the worst cases of malignant endocarditis are secondary to erysipelas; thus, of 23 cases, 3 occurred in connection with this disease. Septic pericarditis and pleuritis also occur. The disease may in rare cases extend to and involve the meninges. Pneumonia

infectiones
infectiū.

nephritis

is not a very common complication. Acute nephritis is also met with; it is often ingrafted upon an old chronic trouble.

Symptoms.—The following description applies specially to erysipelas of the face and head, the form of the disease which the physician is most commonly called upon to treat.

The *incubation* is variable, probably from three to seven days.

The stage of *invasion* is often marked by a rigor, and followed by a rapid rise in the temperature and other characteristics of an acute fever. When there is a local abrasion, the spot is slightly reddened; but if the disease is idiopathic, there is seen within a few hours slight redness over the bridge of the nose and on the cheeks. The swelling and tension of the skin increase and within twenty-four hours the external symptoms are well marked. The skin is smooth, tense, and œdematous. It looks red, feels hot, and the superficial layers of the epidermis may be lifted as small blebs. The patient complains of an unpleasant feeling of tension in the skin; the swelling rapidly increases; and during the second day the eyes are usually closed. The first-affected parts gradually become pale and less swollen as the disease extends at the periphery. When it reaches the forehead it progresses as an advancing ridge perfectly well defined and raised; and often, on palpation, hardened extensions can be felt beneath the skin which is not yet reddened. Even in a case of moderate severity, the face is enormously swollen, the eyes are closed, the lips greatly œdematous, the ears thickened, the scalp is swollen, and the patient's features are quite unrecognizable. The formation of blebs is common on the eyelids, ears, and forehead. The cervical lymph-glands are swollen, but are usually masked in the œdema of the neck. The temperature keeps high without marked remissions for four or five days and then defervescence takes place by crisis. Leucocytosis is present. Kirkbride has noted the presence in one case of leucin and tyrosin in the urine. The general condition of the patient varies much with his previous state of health. In old and debilitated persons, particularly in those addicted to alcohol, the constitutional depression from the outset may be very great. Delirium is present, the tongue becomes dry, the pulse feeble, and there is marked tendency to death from toxæmia. In the majority of cases, however, even with extensive lesions, the constitutional disturbance, considering the height of the fever, range, is slight. The mucous membrane of the mouth and throat may be swollen and reddened. The erysipelatous inflammation may extend to the larynx, but the severe œdema of this part occasionally met with is commonly due to the extension of the inflammation from without inward.

There are cases in which the inflammation extends from the face to the neck, and over the chest, and may gradually migrate or wander over the greater part of the body (*E. migrans*).

The close relation between the erysipelas coccus and the pus organisms is shown by the frequency with which suppuration occurs in facial erysipelas. Small cutaneous abscesses are common about the cheeks and forehead and neck, and beneath the scalp large collections of pus may accumulate. Suppuration seems to occur more frequently in some epidemics than in others, and at the Philadelphia Hospital during one year nearly all the cases in the erysipelas wards presented local abscesses.

Complications.—Meningitis is rare. The cases in which death occurs

with marked brain symptoms do not usually show, post mortem, meningeal affection.

Pneumonia is an occasional complication. Ulcerative endocarditis and septicæmia are more common. Albuminuria is almost constant, particularly in persons over fifty. True nephritis is occasionally seen. Da Costa has called attention to curious irregular returns of the fever which occur during convalescence without any aggravation of the local condition.

Diagnosis.—This rarely presents any difficulty. The mode of onset, the rapid rise in fever, and the characters of the local disease are quite distinctive.

Prognosis.—Healthy adults rarely die. The general mortality in hospitals is about 7 per cent.; in private practice about 4 per cent. (Anders). In the new-born, when the disease attacks the navel, it is almost always fatal. In drunkards and in the aged erysipelas is a serious affection, and death may result either from the intensity of the fever or, more commonly, from toxæmia. The wandering or ambulatory erysipelas, which has a more protracted course, may cause death from exhaustion.

Treatment.—Isolation should be strictly carried out, particularly in hospitals. A practitioner in attendance upon a case of erysipelas should not attend cases of confinement.

The disease is self-limited and a large majority of the cases get well without any internal medication. The diet should be nutritious and light. Large amounts of water should be given. Stimulants are not required except in the old and feeble. For the restlessness, delirium, and insomnia, chloral or the bromides may be given; or, if these fail, opium. When the fever is high the patient may be bathed or sponged, or, in private practice, if there is an objection to this, antipyrin or antifebrin may be given.

Antistreptococcic serum may be tried or, better still, an autogenous vaccine, with the use of which good results have been obtained.

Of internal remedies believed to influence the disease, the tincture of the perchloride of iron has been highly recommended. At the Montreal General Hospital this was the routine treatment, and doses of half a drachm to a drachm were given every three or four hours. I am by no means convinced that it has any special action; nor, so far as I know, has any medicine, given internally, a definite control over the course of the disease.

Of local treatment, the injection of antiseptic solutions at the margin of the spreading areas has been much practised. Two-per-cent. solutions of carbolic acid, corrosive sublimate (1 to 4,000), and the biniodide of mercury have been much used. The injection should be made not into but just a little beyond the border of the inflamed patch. F. P. Henry has treated a large number of cases at the Philadelphia Hospital with the last-mentioned drug, and this mode of practice is certainly most rational.

Of local applications, ichthyol is at present much used (as a salve, 1 to 4 of lanolin), Bichloride of mercury solution (1 to 5,000), salicylic acid (1 to 500), collodion, or ichthyol in collodion (1 to 4), may be used. Painting the skin ahead of the advancing area with tincture of iodine is sometimes effectual. Perhaps as good an application as any is cold water, which was highly recommended by Hippocrates.

dust area with powdered stearate of zinc.
eyes- boric acid unpleas. - eyes. 1-2 drops 10% argyrol. -2-5 c.c. a day

from hydrotherapy- sheets=

5% soln of phenol = n:

Carbolize vaseline may be used to exclude air.
Saturated solution of magnesium sulphate -
collodion painted on

Collodion

1915. 5856 deaths

V. DIPHTHERIA

Definition.—A specific infectious disease, characterized by a local fibrinous exudate, usually upon the mucous membrane of the throat, and by constitutional symptoms due to toxins produced at the site of the lesion. The presence of the Klebs-Loeffler bacillus is the etiological criterion by which true diphtheria is distinguished from other forms of membranous inflammation.

Cases of angina, diagnosed as diphtheria, may be due to other organisms and to these the term diphtheroid is applied. Though usually milder, severe constitutional disturbance, and even paralysis, may follow these diphtheroid forms.

History.—Known in the East for centuries, and referred to in the Babylonian Talmud, it is not until the first century A. D. that an accurate clinical account appears in the writings of Aretæus. The paralysis of the palate was recognized by Ætius (sixth century A. D.) Throat pestilences are mentioned in the Middle Ages. Severe epidemics occurred in Europe in the sixteenth and seventeenth centuries, particularly in Spain. In England in the latter part of the eighteenth century it was described by Fothergill and Huxham, and in America by Bard. Washington died of the disease. Ballonius recognized the affection of the larynx and trachea in 1762, Home in Scotland described it as croup. The modern description dates from Bretonneau, of Tours (1826), who gave to it the name *diphthérite*. Throughout the nineteenth century it prevailed extensively in all known countries, and it is at present everywhere epidemic. After innumerable attempts, in which Klebs took a leading part, the peculiar organism of the disease was isolated by Loeffler. The toxin was determined by the work of Roux, Yersin, and others, and finally the antitoxin was discovered by Behring.

Etiology.—Everywhere endemic in large centres of population, the disease becomes at times epidemic. It is more prevalent on the continent of Europe than in Great Britain, and Ireland has less than other countries. In England and Wales in 1909, 5,476 persons died of the disease, the lowest mortality since 1859. The large cities of the United States have been much afflicted, and widespread epidemics have occurred in country districts. In the tropics it is not a very serious disease. Pandemics occur cyclically, at irregular intervals, under conditions as yet imperfectly known. Dry seasons seem to favor the disease, which, like typhoid fever, shows an autumnal prevalence.

Modes of Infection.—The disease is highly contagious. The bacilli may be transmitted (*a*) from one person to another; few diseases have proved more fatal to physicians and nurses. (*b*) Infected articles may convey the bacilli, which may remain alive for many months; scores of well-attested instances have been recorded of this mode of transmission. (*c*) Persons suffering from atypical forms of diphtheria may convey the disease; nasal catarrh, membranous rhinitis, mild tonsillitis, otorrhœa may be caused by the diphtheria bacilli, and from each of these sources cases have been traced. (*d*) From the throats of healthy contacts—diphtheria carriers, persons who present no signs of the disease—the bacilli have been obtained by culture. (*e*) Even healthy children without any naso-pharyngeal catarrh, who have not been in

contact with the disease, may in large cities harbor the bacilli. In 1,000 children from the New York tenements Shelley found 18 with virulent and 38 with non-virulent bacilli, and the percentage in Chicago has been sometimes much higher. Long after recovery has taken place virulent bacilli have been isolated from the throat. It is important to bear in mind under *d* and *e* that it is only persons who harbor the virulent forms who are capable of transmitting the disease. In schools the interchange of articles, such as sweets, pencils, etc., and the habit which children have of putting everything into their mouths afford endless opportunities for the transmission of the disease. As Westbrook remarks, diphtheria is transmitted usually by almost direct exchange of the flora of the nose and mouth. (*f*) Numerous epidemics have been traced to milk, since Power in 1878 determined this method of spread. Virulent bacilli have been found in the milk, and Dean and Todd and Ashby have found virulent organisms in the acquired lesions on the teats of cows. (*g*) A few instances of accidental infection from cultures and through animals are on record.

Air-borne infections, through sewer gas, soil, drains, dust, etc., are not now held to occur. The disease may be transmitted by direct inoculation.

Predisposing Causes.—Age is the most important. Sucklings are not often attacked, but Jacobi saw three cases in the new-born. "Early in the second year the disposition increases rapidly, and continues at its height until the fifth year. At Baginsky's clinic, Berlin, among 2,711 cases, 1,235 occurred from the second to the fifth years inclusive. In New York between 1891-1900 among the deaths 80.8 per cent. occurred under five, 17 per cent. between five and ten—figures which show the extraordinary preponderance of the disease among children. Girls are attacked in slightly larger numbers than boys. November, December, and January are the months of greatest prevalence in the United States; in London, ~~the months of~~ October and November.

Soil and *altitude* have little or no influence on the prevalence of the disease; nor does race play an important rôle. Individual susceptibility is a very special factor; not only do very many of those exposed escape, but even those, too, in whose throats virulent bacilli lodge and grow.

The Klebs-Loeffler Bacillus occurs in a large number of all suspected cases—72 per cent., based upon an analysis of 27,000 cases in the literature by Graham Smith. It is found chiefly in the false membrane, and does not extend into the subjacent mucosa. The organisms are localized, and only a few penetrate into the interior. Post mortem the bacilli may be found in the blood and in the internal organs. Occasionally they are found in the blood during life. It may be the predominating or sole organism in the broncho-pneumonia so common in the disease. Outside the throat, the Klebs-Loeffler bacillus has been found in diphtheritic conjunctivitis, in otitis media, sometimes in wound diphtheria, upon the genitals, in fibrinous rhinitis, and in ulcerative endocarditis.

Morphological Characters.—The bacillus is non-motile, varies from 2.5 to 3 μ in length and from 0.5 to 0.8 μ in thickness. In appearance it is multiform, varying from short, rather sharply pointed rods to irregular bizarre forms, with one or both ends swollen, and staining more or less unevenly and intensely. Westbrook recognizes three main types—granular, barred, and

J.A.M.A. [illegible]

Schick. reaction -

Diph. toxin injected intracutaneously dermically

Schick 1/50 of min. lethal dose for guinea pig weighing upto 300 gram.

positive reaction - means not much antitoxin.

reaction means immunized to toxin -

reaction begins in 24 hrs. in 36-48 hrs. area reddish gray color

with infiltration - on. size of 10 ¢ piece

after a week the color disappears - - brown discol. a week later

if negative Schick reaction [illegible] for anti toxin

Non-growing reaction are unexplainable diphth.

J.A.M.A. 1915. 65. 585. Neff

Schick used 0.1 cc. of 1-1000 dil. of toxin. = 1/50 of

lethal dose for 5 # 250 gm.

50-60% negative

Active immunization does not seem of great value - It

like same pass. quantities neither does them. if

not Schick reaction - reaction - are last 10-14 days - can [illegible]

from [illegible]

Schick Test - 2700 normal children - 17 to 32 % aged 2-16 yrs.

gave positive react than susceptible to diphth

Reaction is caused by the protein substance of the diphtheria reaction

some give it who are immune to diphtheria = pseudo-reactions.

There are more cases in adults than in children. Antidiphtheritic heating

toxin to 75° C for 5 min. This destroys diph. toxin but toxoid does not

affect protein - Antitoxic reaction usually same as pseudo-reaction

solid staining. Branching forms are occasionally met with. The bacillus stains in sections or on the cover-glass by the Gram method.

The bacillus is very resistant, and cultures have been made from a bit of membrane preserved for five months in a dry cloth. Incorporated with dust and kept moist, the bacilli were still cultivable at the end of eight weeks; kept in a dried state they no longer grew at the end of this period (Ritter).

The Klebs-Loeffler bacillus has very varying grades of virulence down even to complete absence of pathogenic effects. The name pseudo-bacillus of diphtheria should not be given to this avirulent organism.

The Presence of the Klebs-Loeffler Bacillus in Non-membranous Angina and in Healthy Throats.—The bacillus has been isolated from cases which show nothing more than a simple catarrhal angina, of a mild type without any membrane, with diffuse redness, and perhaps huskiness and signs of catarrhal laryngitis. In other cases the anatomical picture may be that of a lacunar tonsillitis. The organisms may be met with in perfectly healthy throats (diphtheria carriers), particularly in persons in the same house, or the ward attendants and nurses in fever hospitals. Following an attack of diphtheria the bacilli may persist in the throat or nose after all the membrane has disappeared for weeks or months—even 15 months. ~~In~~ explanation of this persistence Councilman has called attention to the frequency with which the antrum is affected.

Toxins of the Klebs-Loeffler Bacillus.—Roux and Yersin showed that a fatal result following the inoculation with the bacillus was not caused by any extension of the micro-organisms within the body; and they were enabled in bouillon cultures to separate the bacilli from the poison. The toxin so separated killed with very much the same effects as those caused by the inoculation of the bacilli; the pseudo-membrane, however, is not formed.

Susceptible animals may be rendered immune from diphtheritic infection by injecting weakened cultures of the bacillus or, what is better, suitable doses of the diphtheria toxin. The result of the injections is a febrile reaction which soon passes away and leaves the animal less susceptible to the poison or the living bacilli. By repeating and gradually increasing the quantity of poison injected a high degree of immunity can be produced in large animals, ~~(goat, horse)~~.

The Bacteria Associated with the Diphtheria Bacillus.—The most common is the streptococcus pyogenes. Others, in addition to the organisms constantly found in the mouth, are the micrococcus lanceolatus, the bacillus coli, and the staphylococcus aureus and albus. Of these, probably the streptococcus pyogenes is the most important, as cases of general infection with this organism have been found in diphtheria. The suppuration in the lymph-glands and the broncho-pneumonia are usually ~~(though not always)~~ caused by this organism.

Pseudo-Diphtheria Bacillus; Bacillus Xerosis.—As mentioned above, the Klebs-Loeffler bacillus varies very much in its virulence, and it exists in a form entirely devoid of pathogenic properties. This organism should not, however, be designated pseudo-diphtheria bacillus. The name should be confined to bacilli, which, though resembling the diphtheria bacillus, differ from it not only by abscence of virulence, but also by cultural peculiarities. A similar bacillus, showing, however, certain cultural differences from the

pseudo-diphtheria bacillus, has been repeatedly found in the conjunctival sac in health and disease (*B. xerosis*). *Hoffmann's Bacillus*, which is also spoken of as pseudo-diphtheria bacillus, is a common organism in the throats of healthy persons and is found also in cases of diphtheria; but how far it is responsible for pathological conditions is not yet settled. *Vincent's Bacillus* is a fusiform organism associated with a diphtheroid angina (Vincent's angina), which occurs in two forms: a membranous and an ulcerative and destructive. The fusiform bacilli have been found in healthy throats and also in association with true diphtheria.

Diphtheroid Inflammations.—Under the term diphtheroid may be grouped those membranous inflammations which are not associated with the Klebs-Loeffler bacillus. It is perhaps a more suitable designation than pseudo-diphtheria or secondary diphtheria. As in a great majority of cases the streptococcus pyogenes is the active organism, the term "streptococcus diphtheritis" is often employed. The name "diphtheritis" is best used in an anatomical sense to designate an inflammation of a mucous membrane or integumentary surface characterized by necrosis and a fibrinous exudate, whereas the term "diphtheria" should be limited to the disease caused by the Klebs-Loeffler bacillus. The proportion of cases of diphtheroid inflammation varies greatly in the different statistics. Of the large number of observations made by Park and Beebe (5,611) in New York, 40 per cent. were diphtheroid. Figures from other sources do not show so high a percentage.

Conditions under Which the Diphtheroid Affection Occurs.—Of 450 cases (Park and Beebe), 300 occurred in the autumn months and 150 in the spring; 198 occurred in children from the first to the seventh year. In a large proportion of all the cases the disease develops in children, and can be differentiated from diphtheria proper only by the bacteriological examination. It may be simply an acute catarrhal angina with lacunar tonsillitis. Some of the cases are due to Hoffmann's bacillus, a few to Vincent's fusiform bacillus. The diphtheroid inflammations are particularly prone to develop in connection with the acute fevers.

(*a*) *Scarlet Fever.*—In a large proportion of the cases of angina in scarlet fever the Klebs-Loeffler bacillus is not present. ~~Booker has reported 41 cases complicating scarlet fever, in all of which the streptococci were the predominant organisms.~~ Of the 450 cases of Park and Beebe, 42 complicated scarlet fever. The angina of this disease is not always, however, due to the streptococcus. Where diphtheria is prevalent and opportunities are favorable for exposure, a large proportion of the cases of membranous throats in scarlet fever may be genuine diphtheria.

(*b*) *Measles.*—Membranous angina is much less common in this disease. It occurred in 6 of the 450 diphtheroid cases in New York. Of 4 cases with severe membranous angina at the Boston City Hospital, 1 only presented the Klebs-Loeffler bacillus.

(*c*) *Whooping-cough* may also be complicated with membranous angina. Escherich records 4 cases, in all ~~of which~~ the Klebs-Loeffler bacillus ~~was~~ found.

(*d*) *Typhoid Fever.*—Membranous inflammations in this disease are not very infrequent; they may occur in the throat, the pelvis of the kidney, the bladder, or the intestines. The complication may be caused by the Klebs-Loef-

fler bacillus, but it is frequently a streptococcus infection. Ernst Wagner has remarked upon the greater frequency of these membranous inflammations in typhoid fever when diphtheria is prevailing.

Clinical Features of the Diphtheroid Affection.—The cases, as a rule, are milder, and the mortality is low, only 2.5 per cent. in the 450 cases of Park and Beebe. The diphtheroid inflammations complicating the specific fevers are, however, often very fatal, and a general streptococcus infection is by no means infrequent. As in the Klebs-Loeffler angina, there may be only a simple catarrhal process. In other instances the tonsils are covered with a creamy, pultaceous exudate, without any actual membrane. An important group may begin as a simple lacunar tonsillitis, while in others the entire fauces and tonsils are covered by a continuous membrane, and there is a foul sloughing angina with intense constitutional disturbance.

Are the diphtheroid cases contagious? General clinical experience warrants the statement that the membranous angina associated with the fevers is rarely communicated to other patients. The health department of New York does not keep the diphtheroid cases under supervision. Their investigation of the 450 diphtheroid cases seems to justify this conclusion. Park and Beebe say that "it did not seem that the secondary cases were any less liable to occur when the primary case was isolated than when it was not."

Sequelæ of the Diphtheroid Angina.—The usual mildness of the disease is in part, no doubt, due to the less frequent systemic invasion. Some of the worst forms of general streptococcus infection are, however, seen in this disease. There are no peculiarities, local or general, which ~~can be in any way regarded as~~ are distinctive; and even the most extensive paralysis may follow an angina caused by it.

Morbid Anatomy.—Distribution of Membrane.—A definite membrane was found in 127 of the 220 fatal Boston cases, distributed as follows: tonsils, 65 cases; epiglottis, 60; larynx, 75; trachea, 66; pharynx, 51; mucous membrane of nares, 43; bronchi, 42; soft palate, including uvula, 13; œsophagus, 12; tongue, 9; stomach, 5; duodenum, 1; vagina, 2; vulva, 1; skin of ear, 1; conjunctiva, 1. An interesting point in the Boston investigation was the great frequency with which the accessory sinuses of the nose were found to be infected. In the fatal cases, the exudation is very extensive, involving the uvula, the soft palate, the posterior nares, and the lateral and posterior walls of the pharynx. These parts are covered with a dense pseudo-membrane, in places firmly adherent, in others beginning to separate. In extreme cases the necrosis is advanced and there is a gangrenous condition of the parts. The membrane is of a dirty greenish or gray color, and the tonsils and palate may be in a state of necrotic sloughing. The erosion may be deep enough in the tonsils to open the carotid artery, or a false aneurism may be produced in the deep tissues of the neck. The nose may be completely blocked by the ~~false~~ membrane, which may also extend into the conjunctivæ and through the Eustachian tubes into the middle ear. In ~~cases of~~ laryngeal diphtheria the exudate in the pharynx may be extensive. In many cases, ~~however~~, it is slight upon the tonsils and fauces and abundant upon the epiglottis and the larynx, which may be completely occluded by false membrane. In severe cases the exudate extends into the trachea and to the bronchi of the third or fourth dimension.

In all these situations the membrane varies very much in consistence, depending greatly upon the stage at which death has taken place. If death has occurred early, it is firm and closely adherent; if late, it is soft, shreddy, and readily detached. When firmly adherent it is torn off with difficulty and leaves an abraded mucosa. In the most extreme cases, in which there is extensive necrosis, the parts look gangrenous. In fatal cases the lymphatic glands of the neck are enlarged, and there is a general infiltration of the tissues with serum; the salivary glands, too, may be swollen. In rare instances the membrane extends to the gullet and stomach.

On inspection of the larynx of a child dead of membranous croup the *rima* is seen filled with mucus or with a shreddy material which, when washed off carefully, leaves the mucosa covered by a thin grayish-yellow membrane, which may be uniform or in patches. It covers the ary-epiglottic folds and the true cords, and may be continued into the ventricles or even into the trachea. Above, it may involve the epiglottis. It varies much in consistency. I have seen fatal cases in which the exudation was not actually membranous, but rather friable and granular. It may form a thick, even stratified membrane, which fills the entire glottis. The exudation may extend down the trachea and into the bronchi, and may pass beyond the epiglottis to the fauces. Usually it is readily stripped off from the mucous membrane of the larynx and leaves exposed the swollen and injected mucosa. On examination it is seen that the fibrinous material has involved chiefly the epithelial lining and has not greatly infiltrated the subjacent tissues.

We owe largely to the labors of Wagner, Weigert, and more particularly to the splendid work of Oertel, our knowledge of the *histological changes* which take place in diphtheria. The beginning of the lesion is due to the toxic action of the bacilli growing in the throat. The primary lesion is a necrosis and degeneration of the epithelial tissues. The organisms grow, not in the living, but in the necrotic tissues. The first step is necrosis of the epithelium, often preceded by active proliferation of the nuclei of the cells, which become changed into refractive hyaline masses. From the structures below an inflammatory exudate rich in fibrin factors is poured out, and fibrin is formed when this comes in contact with the necrotic epithelium.

The following are the important changes in the other organs:

Heart.—Fatty degeneration is found in a majority of the cases. It may precede the more advanced degeneration, in which the sarcous elements become swollen and converted into hyaline masses. There is a primary, acute, interstitial myositis, and also a form secondary to degeneration of the heart muscle, to which it is possible that some of the cases of fibrous myocarditis are due. Pericarditis and endocarditis are rare; endocarditis was present in 7 of 220 cases at the Boston City Hospital. The diphtheria bacilli have been found in the vegetations.

The pulmonary complications are the most important, and death is due to them as often as to the throat lesion. Broncho-pneumonia, or, as Councilman terms it, acinous pneumonia, is the most common, and was present in 131 of the 220 Boston cases. Acute lobar pneumonia is rare. The pneumococcus is the principal agent in producing the lung infection. The streptococci and the diphtheria bacilli are frequently met with.

Kidneys.—The lesions, which are due to the action of the toxins, not to

laryngeal diphtheria

the presence of bacteria, vary from simple degeneration to an intense nephritis. There is no specific type of lesion. Interstitial and glomerular nephritis are most common in the older subjects. Degenerative changes are present in a large proportion of all the fatal cases.

The liver and ~~the~~ spleen show the degenerative lesions of ~~the~~ acute infections.

General infection is common, and is about equal with the streptococcus and the diphtheria bacillus. It occurs generally in the grave septic cases, in which type of cases the former organism is more frequently met with.

Symptoms.—The period of incubation is "from two to seven days, oftenest two."

The initial symptoms are those of an ordinary febrile attack—slight chilliness, fever, and aching pains in the back and limbs. In mild cases these symptoms are trifling, and the child may not feel ill enough to go to bed. Usually the temperature rises within the first twenty-four hours to 102.5° or 103° F.; in severe cases to 104° F. In young children there may be convulsions at the outset.

Pharyngeal Diphtheria.—In a typical case there is at first redness of the fauces, and the child complains of slight difficulty in swallowing. The membrane first appears upon the tonsils, and it may be a little difficult to distinguish a patchy diphtheritic pellicle from the exudate of the tonsillar crypts. The pharyngeal mucous membrane is reddened, and the tonsils themselves are swollen. By the third day the membrane has covered the tonsils, the pillars of the fauces, and perhaps the uvula, which is thickened and œdematous, and may fill completely the space between the swollen tonsils. The membrane may extend to the posterior wall of the pharynx. At first grayish-white in color, it changes to a dirty gray, often to a yellow-white. It is firmly adherent, and when removed leaves a bleeding, slightly eroded surface, which is soon covered by fresh exudate. The glands in the neck are swollen, and may be tender. The general condition of a patient in a case of moderate severity is usually good; the temperature not very high, in the absence of complications ranging from 102° to 103° F. The pulse range is from 100 to 120. The local condition of the throat is not of great severity, and the constitutional depression is slight. The symptoms gradually abate, the swelling of the neck diminishes, the membranes separate, and from the seventh to the tenth day the throat becomes clear and convalescence sets in.

Clinically atypical forms are extremely common, and I follow here Koplik's division:

(*a*) There may be no local manifestation of membrane, but a simple catarrhal angina associated sometimes with a croupy cough. The detection in these cases of the Klebs-Loeffler bacillus can alone determine the diagnosis. Such cases are of great moment, inasmuch as they may communicate the severer disease to other children.

(*b*) There are cases in which the tonsils are covered by a pultaceous exudate, not a consistent membrane.

(*c*) Cases presenting a punctate form of membrane, isolated, and usually on the surface of the tonsils.

(*d*) Cases which begin and often run their entire course with the local picture of a typical lacunar amygdalitis. They may be mild, and the local

exudate may not extend, but in other cases there is rapid development of membrane, and extension of the disease to the pharynx and the nose, with severe septic and constitutional symptoms.

(*e*) Under the term "latent diphtheria" Heubner has described cases, usually secondary, occurring chiefly in hospital practice, in young persons the subject of wasting affections, such as rickets and tuberculosis. There are fever, naso-pharyngeal catarrh, and gastro-intestinal disturbances. Diphtheria may not be suspected until severe laryngeal complications develop, or the condition may not be determined until auptosy.

Systemic Infection.—The constitutional disturbance in mild diphtheria is very slight. There are instances, too, of extensive local disease without grave systemic symptoms. As a rule, the general features of a case bear a definite relation to the severity of the local disease. There are rare instances in which from the outset the constitutional prostration is extreme, the pulse frequent and small, the fever high, and the nervous phenomena are pronounced; the patient may sink in two or three days overwhelmed by the intensity of the toxæmia. There are cases of this sort in which the exudate in the throat may be slight, but usually the nasal symptoms are pronounced. The temperature may be very slightly raised or even subnormal. More commonly the severe systemic symptoms appear at a later date when the pharyngeal lesion is at its height. They are constantly present in extensive disease, and when there is a sloughing, fetid condition. The lymphatic glands become greatly enlarged; the pallor is extreme; the face has an ashen-gray hue; the pulse is rapid and feeble, and the temperature sinks below normal. In the most aggravated forms there are gangrenous processes in the throat, and in rare instances, ~~when life is prolonged,~~ extensive sloughing of the tissues of the neck.

Escherich accounts for the discrepancy sometimes observed between the severity of the constitutional disturbance and the intensity of the local process, by assuming varying degrees of susceptibility to the diphtheria bacillus on the one hand, and to its poison on the other hand. With high local susceptibility of a part to the action of the bacillus, with little general susceptibility to the toxin, there is extensive local exudate with mild constitutional symptoms, or *vice versa,* severe systematic disturbance with limited local inflammation.

A leucocytosis is present in diphtheria. Morse does not think it of any prognostic value, since it is present and may be pronounced in mild cases.

Nasal Diphtheria.—In cases of pharyngeal diphtheria the Klebs-Loeffler bacillus is found on the mucous membrane of the nose and in the secretions, even when no membrane is present, but it may apparently produce two affections similar enough locally but widely differing in their general features.

In *membranous or fibrinous rhinitis,* a very remarkable affection seen usually in children, the nares are occupied by thick membranes, but there is an entire absence of any constitutional disturbance. The condition has been studied very carefully by Park, Abbott, Gerber and Podack, and others. Ravenel has collected 77 cases, in 41 of which a bacteriological examination was made, in 33 the Klebs-Loeffler bacillus being present. All the cases ran a benign course, and in all but a few the membrane was limited to the nose, and the constitutional symptoms were either absent or very slight. Remark-

may be simulated by Wiener-process

able and puzzling features are that the disease runs a benign course, and that infection of other children in the family is extremely rare.

On the other hand, nasal diphtheria is apt to present a most malignant type of the disease. The infection may be primary in the nose, and in a case in my wards there was otitis media, and the Klebs-Loeffler bacillus was separated from the discharge before the condition of nasal diphtheria was suspected. While some cases are of mild character, others are very malignant, and the constitutional symptoms most profound. The glandular inflammation is usually very intense, owing, as Jacobi points out, to the great richness of the nasal mucosa in lymphatics. From the nose the inflammation may extend through the tear-ducts to the conjunctivæ and into the antra.

Laryngeal Diphtheria (*Membranous Croup*).—With a very large proportion of all the cases of membranous laryngitis the Klebs-Loeffler bacillus is associated; in a much smaller number other organisms, particularly the streptococcus, are found. Membranous croup, then, may be said to be either genuine diphtheria or diphtheroid in character. Of 286 cases in which the disease was confined to the larynx or bronchi, in 229 the Klebs-Loeffler bacilli were found. In 57 they were not present, but 17 of these cultures were unsatisfactory (Park and Beebe). The streptococcus cases are more likely to be secondary to other acute diseases.

Symptoms.—Naturally, the clinical symptoms are almost identical in the non-specific and specific forms of membranous laryngitis.

The affection begins like an acute laryngitis with slight hoarseness and rough cough, to which the term croupy has been applied. After these symptoms have lasted for a day or two with varying intensity, the child suddenly becomes worse, usually at night, and there are signs of impeded respiration. At first the difficulty in breathing is paroxysmal, due probably to more or less spasm of the muscles of the glottis. Soon the dyspnœa becomes continuous, inspiration and expiration become difficult, particularly the latter, and with the inspiratory movement the epigastrium and lower intercostal spaces are retracted. The voice is husky and may be reduced to a whisper. The color gradually changes and the imperfect aëration of the blood is shown in the lividity of the lips and finger-tips. Restlessness comes on and the child tosses from side to side, vainly trying to get breath. Occasionally, in a severer paroxysm, portions of membrane are coughed out. The fever in membranous laryngitis is rarely very high and the condition of the child is usually very good at the time of the onset. The pulse is always increased in frequency and if cyanosis be present is small. In favorable cases the dyspnœa is not very urgent, the color of the face remains good, and after one or two paroxysms the child goes to sleep and wakes in the morning, perhaps without fever and feeling comfortable. The attack may recur the following night with greater severity. In unfavorable cases the dyspnœa becomes more and more urgent, the cyanosis deepens, the child, after a period of intense restlessness, sinks into a semi-comatose state, and death finally occurs from poisoning of the nerve centres. In other cases the onset is less sudden and is preceded by a longer period of indisposition. As a rule, there are pharyngeal symptoms. The constitutional disturbance may be more severe, the fever higher, and there may be swelling of the glands of the neck. Inspection of the fauces may show the presence of false membranes on the pillars or on the tonsils Bac-

teriological examination can alone determine whether these are due to the Klebs-Loffler bacillus or to the streptococcus. Fagge held that non-contagious membranous croup may spread upward from the larynx just as diphtheritic inflammation is in the habit of spreading downward from the fauces. Ware, of Boston, whose essay on croup is one of the most solid contributions to the subject, reported the presence of exudate in the fauces in 74 out of 75 cases of croup. These observations were made prior to 1840, during periods in which diphtheria was not epidemic to any extent in Boston. In protracted cases pulmonary symptoms may occur, which are sometimes due to the difficulty in expelling the muco-pus from the tubes; in others, the false membrane extends into the trachea and even into the bronchial tubes. During the paroxysm the vesicular murmur is scarcely audible, but the laryngeal stridor may be loudly communicated along the bronchial tubes.

Diphtheria of Other Parts.—Primary diphtheria occurs occasionally in the *conjunctiva*. It follows in some instances the affection of the nasal mucous membrane. Some of the cases are severe and serious, but it has been shown by C. Fränkel and others that the diphtheria bacilli may be present in a conjunctivitis catarrhal in character, or associated with only slight croupous deposits.

Diphtheria of the *external auditory meatus* is seen in rare instances in which a diphtheritic otitis media has extended through the tympanic membrane.

Diphtheria of the *skin* is most frequently seen in the severer forms of pharyngeal diphtheria, in which the membrane extends to the mouth and lips, and invades the adjacent portions of the skin of the face. The skin about the anus and genitals may also be attacked. Pseudo-membranous inflammation is not uncommon on ulcerated surfaces and wounds. In very many of these cases it is a streptococcus infection, but in a majority, perhaps, in which the patient is suffering with diphtheria, the Klebs-Loeffler bacillus will be found in the fibrinous exudate. As proposed by Welch, the term "wound diphtheria" should be limited to infection of a wound by the Klebs-Loeffler bacillus. This "may manifest itself as a simple inflammation, or inflammation with superficial necrosis, or inflammation with more or less adherent pseudo-membrane. The conditions as regards varying intensity and character of the infection, association with other bacteria, particularly streptococci, and the necessity of a bacteriological examination to establish the diagnosis, are in no way different in the diphtheria of wounds from those in diphtheria of mucous membranes. Wound diphtheria may occur without demonstrable connection with cases of diphtheria and without affection of the throat in the individual attacked, but such occurrences are rare" (Welch). Paralysis may follow wound diphtheria. Pseudo-membranous inflammations of wounds are caused more frequently by other micro-organisms, particularly the streptococcus pyogenes, than by the Klebs-Loeffler bacillus. The fibrinous membrane so common in the neighborhood of the tracheotomy wound in diphtheria is rarely associated with the Klebs-Loeffler bacillus. Diphtheria of the genitals is occasionally seen.

Complications and Sequelæ.—Of local complications, hæmorrhage from the nose or throat may occur in the severe ulcerative cases. Skin rashes are not infrequent, particularly the diffuse erythema. Occasionally there is urti-

Hemitus = a sensation of gen.

Sensory paralysis is less common than
motor.

caria and in the severe cases purpura. Fatal cases almost invariably show capillary bronchitis with broncho-penumonia and large patches of collapse, or the septic particles may reach the bronchi and excite gangrenous processes which may lead to severe and fatal hæmorrhage. Jaundice, usually a feature of the toxæmia, is rarely of serious import. Local gangrene may occur.

Albuminuria, present in all severe cases, is alarming only when the albumin is in considerable quantity and associated with epithelial or blood casts. *Nephritis* may appear quite early in the disease, setting in occasionally with complete suppression of the urine. In comparison with scarlet fever the renal changes lead less frequently to general dropsy. In rare instances there may be coma, and even convulsions, without albumin in the urine, and without dropsy.

Of the sequelæ, *paralysis* is by far the most important. It can be experimentally produced in animals by the inoculation of the toxins. The disease is a toxic neuritis, due to the absorption of the poison. The proportion of the cases in which it occurs ranges from 10 to 15 and even to 20 per cent. It is strictly a sequel, coming on usually in the second or third week of convalescence. It may follow very mild cases; indeed, the local lesion may be so trifling that the onset of the paralysis alone calls attention to the true nature of the trouble. It is proportionately less frequent in children than in adults. L. W. Rolleston's recent study of the subject indicates that the early use of antitoxin diminishes the liability to paralysis. In 494 cases collected by Woodhead, the palate was involved in 155, the ocular muscles in 197, in 10 other muscles. Ninety-one of the patients died.

Of the local paralyses the most common is that which affects the palate. This gives a nasal character to the voice, and, owing to a return of liquids through the nose, causes a difficulty in swallowing. The palate is seen to be relaxed and motionless, and the sensation in it is also much impaired. The affection may extend to the constrictors of the pharynx, and deglutition become embarrassed. Within two or three weeks or even a shorter time the paralysis disappears. In many cases the affection of the palate is only part of a general neuritis. Of other local forms perhaps the most common are paralyses of the eye-muscles, intrinsic and extrinsic. There may be strabismus, ptosis, and loss of power of accommodation. Facial paralysis is rare. The neuritis may be confined to the nerves of one limb, though more commonly the legs or the arms are affected together. Very often with the palatal paralysis is associated a weakness of the legs without definite palsy but with loss of the knee-jerk.

The multiple form of diphtheritic neuritis may begin with the palatal affection, or with loss of power of accommodation and loss of the tendon reflexes. This last is an important sign, which, as Bernard, Buzzard, and R. L. MacDonnell have shown, may occur early, but is not necessarily followed by other symptoms of neuritis. There is paraplegia, which may be complete or involve only the extensors of the feet. The paralysis may extend and involve the arms and face and render the patient entirely helpless. The muscles of respiration may be spared.

Heart.—Irregularity of the heart is common. It was present in 60 per cent. of the Boston cases of White and Smith. A murmur at the apex or base of the heart is present in 94 per cent. of all cases. This means, of course, that a majority of all young children with fever have a heart murmur. Only

a few cases of diphtheria have serious heart symptoms, 36 out of the 946 cases specially studied. Rapid action of the heart with gallop rhythm and epigastric pain and tenderness are the most serious symptoms. The cases in which the pulse drops from 110 to 40 or 30 are usually very serious. The heart symptoms are more common in the second or third week of the disease, and fatal dilatation of the heart may come on as late as the sixth or seventh week. It seems probable that the heart weakness is due to granular and fatty degeneration of the muscle substance. Possibly in some of the cases there is degeneration of the vagus, a view which is supported by the frequency of paralysis of the palate with vomiting and epigastric pain and tenderness.

Diagnosis.—The presence of the Klebs-Loeffler bacillus is regarded by bacteriologists as the sole criterion of true diphtheria, and as this organism may be associated with all grades of throat affections, from a simple catarrh to a sloughing, gangrenous process, it is evident that in many instances there will be a striking discrepancy between the clinical and the bacteriological diagnosis.

The bacteriological diagnosis is simple. The plan adopted by the New York Health Department is a model which may be followed with advantage in other cities. Outfits for making cultures, consisting of a box containing a tube of blood-serum and a sterilized swab in a test-tube, are distributed to stations at convenient points ~~in the city~~. A list of these places is published, and a physician can obtain the outfit free of cost. The directions are as follows: "The patient should be placed in a good light, and, if a child, properly held. In cases where it is possible to get a good view of the throat, depress the tongue and rub the cotton swab gently but freely against any visible exudate. In other cases, including those in which the exudate is confined to the larynx, avoiding the tongue, pass the swab far back and rub it freely against the mucous membrane of the pharynx and tonsils. Without laying the swab down, withdraw the cotton plug from the culture-tube, insert the swab, and rub that portion of it which has touched the exudate gently but thoroughly all over the surface of the blood-serum. Do not push the swab into the blood-serum, nor break the surface in any way. Then replace the swab in its own tube, plug both tubes, put them in the box, and return the culture outfit at once to the station from which it was obtained." The culture-tubes which have been inoculated are kept in an incubator at 37° C. for twelve hours and are then ready for examination. Some prefer a method by which the material from the throat collected on a sterile swab, or, as recommended by von Esmarch, on small pieces of sterilized sponge, is sent to the laboratory where the cultures and microscopic examination are made by a bacteriologist.

An immediate diagnosis without the use of cultures is often possible by making a smear preparation of the exudate ~~from the throat~~. The Klebs-Loeffler bacilli may be present in sufficient numbers and ~~may~~ be quite characteristic ~~to an expert~~. In this connection may be given the following statement by Park, who has had ~~such~~ an exceptional experience: "The examination by a competent bacteriologist of the bacterial growth in a blood-serum tube which has been properly inoculated and kept for fourteen hours at the body temperature can be thoroughly relied upon in cases where there is visible membrane in the throat, if the culture is made during the period in which the membrane is forming, and no antiseptic, especially no mercurial solution, has lately been applied. In cases in which the disease is confined to the larynx or

heart block.

Heart block is responsible in some of these.

boss v cut was 3.8%. 12

bronchi, surprisingly accurate results can be obtained from cultures, but in a certain proportion of cases no diphtheria bacilli will be found in the first culture, and yet will be abundantly present in later cultures. We believe, therefore, that absolute reliance for a diagnosis can not be placed upon a single culture from the pharynx in purely laryngeal cases."

Where a bacteriological examination can not be made, the practitioner must regard as suspicious all forms of throat affections in children, and carry out measures of isolation and disinfection. In this way alone can serious errors be avoided. It is not, of course, in the severer forms of membranous angina that mistake is likely to occur, but in the various lighter forms, many of which are in reality due to the Klebs-Loeffler bacillus.

A large proportion of the cases of diphtheroid inflammation of the throat are due to the streptococcus pyogenes. They are usually milder, and the liability to general infection is less intense; still, in scarlet fever and other specific fevers some of the most virulent cases of throat disease which we see, with intense systemic infection, are caused by this micro-organism. These streptococcus cases are probably much less numerous than the figures given would indicate. The more careful examinations in the diphtheria pavilions of hospitals, particularly in Europe, have shown that in the large majority of cases admitted the Klebs-Loeffler bacillus is present. The question of the diagnosis between scarlet fever with severe angina and diphtheria is discussed in the section on scarlet fever.

Prognosis.—The outlook in any case depends on the promptness and thoroughness with which antitoxin treatment is carried out. In hospital practice the mortality was formerly from 30 to 50 per cent. In the Boston City Hospital the death-rate between 1888 and 1894 was only once below 40 per cent., and in 1892 and 1893 rose to nearly 50 per cent. Following the introduction of antitoxin from 1895 to 1908 the death-rate has not once been above 15 per cent., and of late years has been ~~about~~ 10 ~~or 12~~ per cent. (McCollom). In country places the disease may display an appalling virulence. In cases of ordinary severity the outlook is usually good. Death results from involvement of the larynx, septic infection, sudden heart-failure, diphtheritic paralysis, occasionally from uræmia, and sometimes from broncho-penumonia occurring during convalescence. In England and Wales in 1909 there were 5,476 deaths, compared with 9,130, the average number in the previous decennium (Tatham). Of late years the mortality has been steadily falling. In Boston during the ten years ending 1903 the mortality per 10,000 of the living has ranged from 30.65 to 88.73. The mortality has greatly decreased, from 18.03 per 10,000 living in 1894 to 3.51 in 1903 (McCollom).

Prophylaxis.—Isolation of the sick, disinfection of the clothing and of everything that has come in contact with the patient, careful scrutiny of the milder cases of throat disorder, and more stringent surveillance in the period of convalescence are the essential measures to prevent the spread of the disease. Suspected cases in families or schools should be at once isolated or removed to a hospital for infectious disorders. When a death has occurred from diphtheria, the body should be wrapped in a sheet which has been soaked in a corrosive-sublimate solution (1 to 2,000), and placed in a closely sealed coffin. The funeral should always be private.

In cases of well-marked diphtheria these precautions are usually carried

out, but the chief danger is from the milder cases, particularly the ambulatory form, in which the disease has perhaps not been suspected. But from such patients mingling with susceptible children the disease is often conveyed. The healthy children in a family in which diphtheria exists may carry the disease to their school-fellows. The question of the influence of isolation hospitals on the spread of the disease has, I think, been solved in Boston, a city which has suffered terribly from diphtheria. The ratio of mortality per 10,000 living in 1893 was 11+, and in 1894 it was 19+. In 1895 the infectious pavilion was opened. Prior to that year only about 10 per cent. of the reported cases were treated in hospital; in succeeding years 50 per cent. were treated in hospital. In 1898 the mortality per 10,000 had fallen to 3, and in 1899 it was 4.9.

A very important matter in the prophylaxis relates to the period of convalescence. It has been shown by numerous observations that, after all the membrane has cleared away, virulent bacilli may persist in the throat from periods ranging from six weeks to six months, or even longer. The disease may be communicated by these *carriers* and they should be isolated and the throat carefully treated, but there are cases very resistant to all forms of throat antiseptics. Antitoxin may be applied locally to the throat and spraying the throat and nose with a bouillon culture of *staphylococcus pyogenes aureus* is stated to be an efficient measure.

It cannot be too strongly emphasized that the important elements in the prophylaxis of diphtheria are the rigid scrutiny of the milder types of throat affection, and the thorough isolation and disinfection of the individual patients. During an epidemic there should be repeated examinations made of all those exposed to infection.

Careful attention should be given to the throats and mouths of childen, particularly to the teeth and tonsils, as Caillé has urged. Swollen and enlarged tonsils should be removed. Cats and dogs may carry infection and should be excluded from coming in contact with patients. In persons exposed, the antiseptic mouth washes, such as corrosive sublimate (1 to 10,000), hydrogen peroxide, or swabbing the throat with a diluted Loeffler's solution, should be employed. Physicians and nurses should wear gowns and caps, and cover the nose and mouth with gauze.

Immunization.—The giving of antitoxin as a preventive measure has an important place. Its value is well shown in the children's hospitals in which it is given as a routine prophylactic measure. The usual dose for adults is 1,000 units, for older children 750 units, and for children under two years of age 500 units. The immunity lasts about three weeks. The same precautions should be taken as in giving antitoxin to those with the disease.

Treatment.—The important points are hygienic measures to prevent the spread of the malady, local treatment of the throat to destroy the bacilli, medication, general or specific, to counteract the effects of the toxins, and, lastly, to meet the complications and sequelæ.

(*a*) Hygienic Measures.—The patient should be in a room from which the carpets, curtains, and superfluous furniture have been removed. The temperature should be about 68°, and thorough ventilation should be secured. The air may be kept moist by a kettle or a steam-atomizer. If possible, only the nurse, the child's mother, and the doctor should come in contact with the

Índice de las ilustraciones

sommaire

Table des matières

Ground tungsten - nitrogen with hot air by an oil.
Sulphuric acid (one drop to 1 ml) or 2 % nitric acid solution.
Temp. ordinary air oven (100 - 150°/110°). Frequency 3 at
by ordinary glass [illegible].

If diff. to swallow, by tube.

patient. During the visit the physician should wear a gown and cap, and on leaving the room he should thoroughly wash his hands and face in a corrosive-sublimate solution. The strictest quarantine should be employed against other members in the house.

(*b*) LOCAL TREATMENT.—In mild cases the throat symptoms are alone prominent. Vigorous local treatment from the outset should be carried out, taking especial care in all instances to avoid mechanical injury to the tissues. A very large number of solutions have been recommended. They are best employed with a swab of cotton-wool or a soft sponge, or irrigation with hot antiseptic solutions may be used. The direct application with a swab of cotton-wool or sponge is, as a rule, effective. In many young children it is really a most trying procedure to carry out the treatment, and sometimes one is compelled to desist. In infants the disinfecting fluids are sometimes better applied through the nostrils, but the irrigating stream should be allowed to flow very gently. The following solutions may be employed:

Loeffler's solution: Menthol, 10 grams dissolved in toluol to 36 c. c.; Liq. Ferri sesquichlorati, 4 c. c.; alcohol absol., 60 c. c.

Corrosive sublimate, 1 to 1,000, either alone or with tartaric acid, 5 grams to the litre.

~~Carbolic acid, 3 per cent. in 30 per cent. alcohol solution, is much employed; some prefer to touch the small spots of exudate with pure carbolic acid.~~

Another solution is: The tincture of the perchloride of iron, a drachm and a half, in glycerine, one ounce, water, one ounce, with from 15 to 20 minims of carbolic acid. ~~Chlorine water~~, Boric acid, peroxide of hydrogen, ~~iodoform, lactic acid, trypsin, and papain are also recommended~~.

In many cases the use of an alkaline ~~solution~~ or ~~even of a~~ saline solution is more satisfactory than antiseptics.

Nasal diphtheria requires prompt and thorough disinfection of the passages. Jacobi recommends chloride of sodium, saturated boric acid, or 1 part of bichloride of mercury, 35 of chloride of sodium, and 1,000 of water, or the 1-per-cent. solution of carbolic acid. Loeffler's solution may be diluted and applied with a syringe or spray. To be effectual the injection must be properly given. The nurse should be instructed to pass the nozzle of the syringe horizontally, not vertically; otherwise the fluid will return through the same nostril.

When the larynx becomes involved, a steam tent may be arranged ~~upon the bed~~, so that the child may breathe an atmosphere saturated with moisture. When the signs of obstruction are marked there should be no delay in the performance of intubation or tracheotomy. The choice between these must depend on the circumstances in each case. Intubation may be regarded as the operation of choice in the majority of cases. Tracheotomy is preferable in adults and may be the operation of necessity. The patient requires more skillful care after intubation than after tracheotomy.

Hot applications to the neck are usually very grateful, particularly to young children, though in the case of older children and adults the ice poultices are to be preferred.

(*c*) GENERAL MEASURES.—Every effort should be made to nourish the patient. The food should be liquid—milk, beef juices, barley water, ice cream, albumen water, and soups. The patient should be encouraged to drink

water freely. If there is difficulty in taking it by mouth, it should be given by the bowel or by infusion. The bowels should be freely opened, for which a calomel and saline purge is usually best. When the pharyngeal involvement is very great and swallowing painful, nutritive enemata should be used. In cases with severe constitutional symptoms stimulants should be given early.

Medicines given internally are of very little avail, but there is still a widespread belief in the profession that forms of mercury are beneficial. The tincture of the perchloride of iron is also very warmly recommended. We must rely on general measures of feeding and stimulation to support the strength.

(*d*) Antitoxin Treatment.—As the years go on additional experience has shown that, thoroughly carried out, this method of treatment is both safe and efficacious. There are no reasonable grounds for skepticism on the part of intelligent practitioners, and still less on the part of those in charge of the hospitals for infectious diseases.

The principle of action depends on the circumstance that the blood-serum of an animal rendered immune, when introduced into another animal, protects it from infection with the diphtheria bacilli, and has also an important curative influence upon diphtheria, whether artificially given to animals, or spontaneously acquired by man. In the preparation of the blood-serum a uniform standard strength is procured. The antitoxin unit is the amount of antitoxin which, injected into a guinea-pig of 250 grams in weight, neutralizes 100 times the minimum fatal dose of toxin of standard strength.

Dosage.—This is one of the most important questions relating to the use of the antitoxin. J. H. McCollom, of the Boston City Hospital, who has probably had a richer experience with the disease than any man in the United States, insists that the guiding practice in the use of the antitoxin is to give it until the characteristic effects are produced, whether 4,000 or 70,000 units be required for this result. He very rightly remarks that in the case of a patient ill with diphtheria there is no way of estimating the quantity of toxin generated by the membrane, and therefore one must administer the agent until the characteristic effect is produced—viz., the shriveling of the membrane, the diminution of the nasal discharge, the correction of the fetid odor, and a general improvement in the condition of the patient. No case, he says, in the acute stage should be considered hopeless. "When one sees a patient with membrane covering the tonsils and uvula, profuse sanious discharge from the nose, spots of ecchymosis on the body and extremities, cold, clammy hands and feet, a feeble pulse, and the nauseous odor of diphtheria, and finds that after the administration of 10,000 units of antitoxin in two doses the condition of the patient improves slightly; that after 10,000 units more have been given there is a marked abatement in the severity of the symptoms; that when an additional 10,000 units have been given the patient is apparently out of danger, and eventually recovers—one must believe in the curative power of antitoxin. When one sees a patient in whom the intubation tube has been repeatedly clogged, when the hopeless condition of the patient changes for the better after the administration of 50,000 units, one can not help but be convinced of the importance of giving large doses of antitoxin in the very severe and apparently hopeless cases. In the majority of instances these large doses are not required, particularly if the patients are seen early in the attack, 4,000

circulation - early antitoxin in local treatment - Hypnotics
may use ~~caution~~ digitalis, camphor, epinephrin & saline
solutions given by rectum or subcut. is useful

to 6,000 units being enough to produce the characteristic effect on the membrane." The initial dose in ordinary cases should be from 3,000 to 5,000 units and the result must determine the frequency of repetition. In severe cases and in laryngeal diphtheria the first dose should be from 5,000 to 10,000 units, repeated in six hours. The danger is in giving too small and not too large a dose.

Administration.—Antitoxin should be injected into the subcutaneous cellular tissue; the abdominal wall, the thoracic wall and the back near the angle of the scapula are the usual sites. The skin and needle should be thoroughly clean.

Favorable effects are seen in the improvement in both the local and general condition. The swelling of the fauces subsides, the membrane begins to disappear, the temperature falls, and the pulse becomes slower.

Untoward Effects.—"Serum Disease."—This may appear in any normal individual and is due to the serum and not to the antitoxin. Following the injection after a varying interval, which varies from one to eighteen days, but is usually between seven and ten days, a local reaction appears which may be accompanied by general symptoms. The site of injection shows œdema, urticaria or erythema, which may become more or less general. Malaise, vomiting, fever, adenitis, albuminuria, and arthralgia may accompany this. The symptoms are usually not severe and disappear in three or four days. Calcium lactate (gr. xv, 1 gm. three times a day) may be given as a prophylactic or when the symptoms have appeared. There is another reaction which is much more serious. In individuals who have been given antitoxin previously, even at a long interval—who have been sensitized—in some who have had asthma and in some of those who are affected by the smell or proximity of horses, an acute dangerous condition may be caused by the injection of serum—anaphylaxis. This comes on very suddenly and with acute symptoms, among which are extreme distress, dyspnœa, cyanosis, œdema, collapse, respiratory failure and convulsions; death may follow rapidly. Fortunately this occurs rarely, but its possibility should be kept in mind, and before giving antitoxin the patient should be asked as to a history of asthma, an idiosyncrasy to horses and previous administration of antitoxin. If there is any reason to suspect the possibility of a reaction, the patient should be tested by the administration of two or three drops of antitoxin, which will not give a dangerous reaction. If he is susceptible a reaction usually occurs in an hour, but it is safer to wait three hours. The skin reaction may also be tried (Moss), but this demands twenty-four hours, too long to wait if the diphtheria is severe. If the patients are sensitive and the need of antitoxin is great, small doses should be given at ~~short~~ intervals. In the absence of reaction it is safe to give the usual dose, for a sensitized individual, after receiving a small dose, is refractory to larger doses some hours later. This must be kept in mind in the case of patients who have a relapse, as if seven days have elapsed since the first dose the patient may be sensitized. Children seem to be much less liable to sensitization than adults. If anaphylaxis should occur, morphia (gr. ¼) and atropine (gr. 1-100) hypodermically should be given at once. Artificial respiration should be done if there is respiratory failure.

Results.—Of 183,256 cases treated in 150 cities previous to the serum period, the mortality was 38.4 per cent. Since the introduction of serum

among 132,548 cases, there was a mortality of 14.6 per cent. Leaving out those not treated with the serum, the mortality was 9.8 per cent. (Edwin Rosenthal). The figures of the Boston City Hospital are of special value, as the number of cases is large, the character severe, and the Director of the South Department, Dr. McCollom, has had faith in the treatment and courage in carrying it out.

In Chicago, for fifteen years before antitoxin treatment, the death rate was 144, for the fifteen years after its introduction it was 38 (G. B. Young).

Convalescence.—This demands special care, particularly if there are signs of cardiac disturbance. In this event the patient should be kept absolutely at rest and this may be necessary for a long period. Nourishment should be given freely, strychnine administered in full doses, and iron with arsenic if there is anæmia. If swallowing becomes difficult it is wise to use the stomach tube for feeding. With the post-diphtheritic paralysis the patients should be kept in bed, fed liberally and given strychnine hypodermically. Antitoxin is valuable in doses of 1,000 to 3,000 units daily. In the chronic forms with muscular wasting, electricity and massage should be used. The patient should not be discharged from quarantine until two successive cultures from the throat and nose, two days apart, have been negative.

VI. THE PNEUMONIAS AND PNEUMOCOCCIC INFECTIONS

A variety of diseases are caused by the pneumococcus, among which lobar and lobular pneumonia are the most important. Various inflammatory affections of the lungs may be caused by other organisms, but the pneumococcus plays the important rôle in the common ~~fibrinous~~ pneumonia and in the ordinary broncho-pneumonia. It may set up also many local affections and is the cause of many terminal infections in chronic diseases.

A. LOBAR PNEUMONIA

(Croupous or Fibrinous Pneumonia, Lung Fever)

Definition.—An infection caused by the pneumococcus of Fraenkel, characterized by inflammation of the lungs, a toxæmia of varying intensity and a fever which usually terminates by crisis. Secondary infective processes are common.

History.—The disease was known to Hippocrates and the old Greek physicians, by whom it was confounded with pleurisy. Among the ancients, Aretæus gave a remarkable description. "Ruddy in countenance, but especially the cheeks; the white of the eyes very bright and fatty; the point of the nose flat; the veins in the temples and neck distended; loss of appetite; pulse, at first, large, empty, very frequent, as if forcibly accelerated; heat indeed, externally, feeble, and more humid than natural, but, internally, dry and very hot, by means of which the breath is hot; there is thirst, dryness of the tongue, desire of cold air, aberration of mind; cough mostly dry, but if anything be brought up it is a frothy phlegm, or slightly tinged with bile, or with a very florid tinge of blood. The blood-stained is of all others the worst." At the end of the seventeenth and the beginning of the eighteenth century Morgagni

carrier. Hecklorin + Rabbitpest. J.A.V.M.A. 1915 64. 1584

Kaolin - blue nitrate near g.s.t. by rubber tube or glass tube
over the nasal surfaces.

Swallow 1/3 teaspoonful 4 or 5 times an hour each day

—

mightbe used as treatment

Rate per million

Sept-Oct 1915. deaths - Lobar Pn. 10575 — 291 (291)
Bronchop - 23229 — 653
notified - 15163 — 412
48967 — 1356

Rate per million

and rate q. numerically constant!

and Valsalva made many accurate clinical and anatomical observations on the disease. Our modern knowledge dates from Laënnec (1819), whose masterly description of the physical signs and morbid anatomy left very little for subsequent observers to add or modify.

Incidence.—One of the most widespread and fatal of all acute diseases, pneumonia has become the "Captain of the Men of Death," to use the phrase applied by John Bunyan to consumption. In England and Wales in 1909 there were 46,108 deaths from this cause; 6,072 were attributed to lobar pneumonia, 19,795 to broncho-pneumonia, ~~11 to epidemic pneumonia~~, while 20,230 were registered as from pneumonia without further qualification. The United States Census Report for 1910 gives 147.7 deaths from pneumonia per 100,000 population. An apparent increase is noted in the larger cities, particularly New York and Chicago.

Careful studies of tropical pneumonia have been made at Panama. At the Ancon Hospital among 574 cases the mortality was 37 per cent.; among the mixed races, natives of the Isthmus, from 50 to 60 per cent. The same high death rate prevails at the Colon Hospital. Among the natives employed in the Transvaal mines the disease is very fatal, killing a larger number than any other disease, tuberculosis coming second. It is more particularly among the natives during the first month of work in the mines, 443 per thousand of all deaths during this period. There is a marked decline in succeeding periods of six months—from 16 per thousand in the first six months to 9.24 per thousand in the second six months, and 5.5 per thousand in the third six months. Of a total of 6,333 deaths in 1909-1910 in the labor area, 2,264, more than one-third, were due to pneumonia (G. D. Maynard). The case mortality is not extraordinarily high; Dr. Irvine tells me not more than from 20 to 25 per cent. ~~The mine owners have at last aroused to the necessity of doing something to check this appalling mortality and Sir Almroth Wright is making a study of the local conditions~~.

Etiology.—Age.—To the sixth year the predisposition to pneumonia is marked; it diminishes to the fifteenth year, but then for each subsequent decade it increases. For children Holt's statistics of 500 cases give: First year, 15 per cent.; from the second to the sixth year, 62 per cent.; from the seventh to the eleventh year, 21 per cent.; from the twelfth to the fourteenth year, 2 per cent. Lobar pneumonia has been met with in the new-born. The relation to age is well shown in the U. S. Census Report for 1900. The death-rate in persons from fifteen to forty-five years was 100.05 per 100,000 of population; from forty-five to sixty-five years it was 263.12; and in persons sixty-five years of age and over it was 733.77. Pneumonia may well be called the friend of the aged. Taken off by it in an acute, short, not often painful illness, the old escape those "cold gradations of decay" that make the last stage of all so distressing.

Sex.—Males are more frequently affected than females—533 to 125 in the Johns Hopkins Hospital series.

Race.—In the United States pneumonia is more fatal in negroes than among the whites. This was not so marked in our figures at the Johns Hopkins Hospital, but at the Charité Hospital, New Orleans, and at the Ancon and Colon hospitals of the Canal Zone the death rate among the negroes is much higher.

Social Condition.—The disease is more common in the cities. Individuals who are much exposed to hardship and cold are particularly liable to the disease. Newcomers and immigrants are stated to be less susceptible than native inhabitants.

Personal Condition.—Debilitating causes of all sorts render individuals more susceptible. Alcoholism is perhaps the most potent predisposing factor. Robust, healthy men are, however, often attacked.

Previous Attack.—No other acute disease recurs in the same individual with such frequency. Instances are on record of individuals who have had ten or more attacks. The percentage of recurrences has been placed as high as 50. Netter gives it as 31, and he has collected the statistics of eleven observers who place the percentage at 26.8. Among the highest figures for recurrences are those of Benjamin Rush, 28, and Andral, 16.

Trauma—Contusion-pneumonia.—Pneumonia may follow directly upon injury, particularly of the chest, without necessarily any lesion of the lung. Litten gives 4.4 per cent., Stern 2.8 per cent. Stern describes three clinical varieties: first, the ordinary lobar pneumonia following a contusion of the chest wall; secondly, atypical cases, with slight fever and not very characteristic physical signs; thirdly, cases with the physical signs and features of broncho-pneumonia. The last two varieties have a favorable prognosis. According to Ballard, workers in certain phosphate factories, where they breathe a very dusty atmosphere, are particularly prone to pneumonia.

Cold has been for years regarded as an important etiological factor. The frequent occurrence of an initial chill has been one reason for this widespread belief. As to the close association of pneumonia with exposure there can be no question. We see the disease occur either promptly after a wetting or a chilling due to some unusual exposure, or come on after an ordinary catarrh of one or two days' duration. Cold is now regarded simply as a factor in lowering the resistance of the bronchial and pulmonary tissues.

Climate and Season.—Climate does not appear to have very much influence, as pneumonia prevails equally in hot and cold countries. It is stated to be more prevalent in the Southern than in the Northern States, but an examination of the Census Reports shows that there is very little difference in the various State groups.

The disease is less prevalent in England than in the United States, where the dry, overheated air of the houses favors catarrhal processes in the air passages, though I know of no figures which show a greater incidence of pneumococci in the mouths and throats of the inhabitants of the latter country.

Much more important is the influence of *season*. Statistics are almost unanimous in placing the highest incidence of the disease in the winter and spring months. In Montreal, January, the coldest month of the year, but with steady temperature, has usually a comparatively low death-rate from pneumonia. The large statistics of Seitz from Munich and of Seibert of New York give the highest percentage in February and March.

Bacteriology of Acute Lobar Pneumonia.—(*a*) Micrococcus lanceolatus, Pneumococcus or Diplococcus pneumoniæ of Fraenkel and Weichselbaum.—In September, 1880, Sternberg inoculated rabbits with his own saliva and isolated a micrococcus. The publication was not made until April, 1881. Pasteur discovered the same organism in the saliva of a child dead

Some of mouth dwellers (Actinomycetes) are not I. II & III
but I II & III found in mouths of persons near but

Types of [illegible]

Col.			mortality
1/3	Type 1.	33% -	25-30
1/3	" 2.	27% -	25-30
10-15%	" 3	8% -	45-50
[illegible]	" 4.	31%	12

[illegible]

[illegible]?

of hydrophobia in December, 1880, and the priority of the discovery belongs to him, as his publication is dated January, 1881. There was, however, no suspicion that this organism was concerned in the etiology of lobar pneumonia, and it was not really until April, 1884, that Fraenkel determined that the organism found by Sternberg and Pasteur in the saliva, and known as the coccus of sputum septicæmia, was the most frequent germ in pneumonia.

The organism is a somewhat elliptical, lance-shaped coccus, usually occurring in pairs; hence the term diplococcus. It is readily demonstrated in cover-glass preparations with the usual dyes and by the Gram method. About the organism in the sputum a capsule can always be demonstrated. Its cultural and biological properties present many variations, for a consideration of which the student is referred to the text-books on bacteriology. Scarcely any peculiarity is constant. A large number of varieties have been cultivated. Its kinship to *Streptococcus pyogenes* is regarded by many as very close, but the alkaline serum-water medium, containing inulin, recommended by His, serves to distinguish the pneumococcus from the streptococcus.

Distribution in the Body.—In the bronchial secretions and in the affected lung the pneumococcus is readily demonstrated in smears, and in the latter in sections. With the more recent methods it is possible to isolate the pneumococcus from the blood in a large proportion of all cases.

(*b*) Pneumococcus Under Normal Conditions.—(1) *In the Mouth.*—The studies of the New York Pneumonia Commission have shown that the pneumococcus is present in the mouths of a large proportion of healthy individuals, the various observers giving 80 to 90 per cent. of positive results. The virulence is not always uniform, and Longcope and Fox were able to show that the saliva of the same individual increased in virulence during the winter months. Some persons always harbor a virulent variety. Buerger at the Mt. Sinai Hospital studied the communicability of the organism from one person to another, and it was found repeatedly that normal individuals—*i. e.*, persons in whose mouths the pneumococcus was proved by repeated examinations to be absent—acquired the organisms by association with cases of pneumonia, or with healthy persons in whose saliva pneumococci were present.

(2) *Outside the Body.*—The viability of the pneumococcus is not great. It has been found occasionally in the dust and sweepings of rooms, but Wood has shown (New York Commission Report) that the germs exposed to sunlight die in a very short time—an hour and a half being the limit. In moist sputum kept in a dark room the germs lived ten days, and in a badly ventilated room in which a person with pneumonia coughed, the germs suspended in the air retained their vitality for several hours.

(*c*) Bacillus pneumoniæ of Friedländer.—This is a larger organism than the pneumococcus, and appears in the form of plump, short rods. It also shows a capsule, but presents marked biological and cultural differences from Fraenkel's pneumococcus. It may cause broncho-pneumonia and other affections, and is not a cause of genuine lobar pneumonia. The exudate caused by this bacillus is usually more viscid and poorer in fibrin than that in diplococcus pneumonia.

(*d*) Other Organisms.—Various bacteria may be associated with the pneumococcus in lobar pneumonia, the most common of these being *Streptococcus pyogenes*, the pyogenic staphylococci, and Friedländer's pneumo-

bacillus; but while these latter may cause broncho-pneumonia, they have not been satisfactorily demonstrated to be other than secondary invaders in lobar pneumonia. Likewise the pneumonias caused by *Bacillus typhosus, Bacillus diphtheriæ,* and the influenza bacillus are not to be identified with true lobar pneumonia.

Clinically, the *infectious nature* of pneumonia was recognized long before we knew anything of the pneumococcus. It may occur in endemic form, localized in certain houses, in barracks, jails, and schools. As many as ten occupants of one house have been attacked. I have seen three members of a family consecutively attacked with a most malignant type of pneumonia. Among the more remarkable endemic outbreaks is that reported by W. B. Rodman, of Frankfort, Ky. In a prison with a population of 735 there occurred in one year 118 cases of pneumonia with 25 deaths. The disease may assume epidemic proportions. In the Middlesborough epidemic, so carefully studied by Ballard, there were 682 persons attacked, with a mortality of 21 per cent. During some years pneumonia is so prevalent that it is practically pandemic. Direct contagion is suggested by the fact that a patient in the next bed to a pneumonia case may take the disease, or 2 or 3 cases may follow in rapid succession in a ward. It is very exceptional, however, for nurses or doctors to be attacked.

Conditions Favoring Infection.—Some have been referred to; of many we are still ignorant. The all-important fact is that a majority of us harbor the germ in the mouth or nose or throat. It has been shown that the virulence varies at different periods, and with this may be associated the well-known seasonal prevalence of the disease. Some individuals are less resistant, and in no other acute disease may so many successive attacks occur in the same person. It is notorious that the negro race in the United States, in Panama, and in South Africa shows an extreme susceptibility; on the other hand, the Chinese in the South African compounds showed an extraordinary resistance to the disease (Porter). Probably for each one of us it is a battle between the degree of resistance and the virulence of the organism which we harbor. A catarrh of the upper air passages, exposure, alcoholism, etc., weaken the defences, lower the resistance as we say, and give the ever-present enemy a chance, either for frontal attack in the lungs, in an acute pneumonia, or to make a flanking assault on some unprotected region, causing a peritonitis, otitis, sinusitis, etc. The explosive onset of the disease bears a certain resemblance to the anaphylactic reaction.

Immunity, Serum and Vaccine Therapy.—In spite of an extraordinary amount of work, our knowledge of the subjects is still very unsatisfactory. The pneumococcus does not produce in artificial cultures any strong, soluble toxin analogous to the diphtheria toxin or the tetanus toxin, but its poison is contained within the bacterial cells, from which it may be extracted in various ways, or it may be set free from the dead or degenerated cocci. The possibility that the pneumococcus may secrete a soluble toxin in the infected human or animal body may be admitted, but of this there is no conclusive demonstration. By the use of living or dead pneumococci or their extracts, animals may be vaccinated so that their blood-serum is capable of protecting susceptible animals against many times the minimal fatal dose of the virulent

Some observers suggest that pneumococci in mouth
are usually virulent Type I

In the Rockefeller Institute studies, the section on type I has apparently been of value. The subject is in need of further investigation

pneumococcus. Strong protective serum has thus been obtained from rabbits, horses, asses, cows, and other animals subjected to repeated inoculations with dead and living cultures of the pneumococcus. This specific serum is neither antitoxic nor bactericidal. Metchnikoff believes that it acts by stimulating the leucocytes to ingest and destroy the pneumococci; Wright and Douglas and others have demonstrated opsonins in the circulating blood which enter into chemical combination with the cocci, rendering them thereby more readily engulfed and digested by the phagocytes.

Many trials have been made of the curative value of antipneumococcic serum in the treatment of pneumonia, but thus far it has not been shown to influence in any marked degree the course of the disease in man. Favorable results are claimed to have been obtained from Roemer's serum. Vaccine therapy is on its trial in the disease and the results so far have not been very satisfactory.

Morbid Anatomy.—Since the time of Laënnec, pathologists have recognized three stages in the inflamed lung: engorgement, red hepatization, and gray hepatization.

In the stage of *engorgement* the lung tissue is deep red in color, firmer to the touch, and more solid, and on section the surface is bathed with blood and serum. It still crepitates, though not so distinctly as healthy lung, and excised portions float. The air-cells can be dilated by insufflation from the bronchus. The capillary vessels are greatly distended, the alveolar epithelium swollen, and the air-cells occupied by a variable number of blood corpuscles and detached alveolar cells. In the stage of *red hepatization* the lung tissue is solid, firm, and airless. If the entire lobe is involved it looks voluminous, and shows indentations of the ribs. On section, the surface is dry, reddish-brown in color, and has lost the deeply congested appearance of the first stage. One of the most remarkable features is the friability; in striking contrast to the healthy lung, which is torn with difficulty. The surface has a granular appearance due to the fibrinous plugs filling the air-cells. The distinctness of this appearance varies greatly with the size of the alveoli, which are about 0.10 mm. in diameter in the infant, 0.15 or 0.16 in the adult, and from 0.20 to 0.25 in old age. On scraping the surface with a knife a reddish viscid serum is removed, containing small granular masses. The smaller bronchi often contain fibrinous plugs. If the lung has been removed before the heart, it is not uncommon to find solid moulds of clot filling the blood-vessels. Microscopically, the air-cells are seen to be occupied by coagulated fibrin in the meshes of which are red blood-corpuscles, mononuclear and polynuclear leucocytes, and alveolar epithelium. The alveolar walls are infiltrated and leucocytes are seen in the interlobular tissues. Cover-glass preparations from the exudate, and thin sections show, as a rule, the diplococci, already referred to, many of which are contained within cells. Staphylococci and streptococci may also be seen in some cases. In the stage of *gray hepatization* the tissue has changed from a reddish-brown to a grayish-white color. The surface is moister, the exudate obtained on scraping is more turbid, the granules in the acini are less distinct, and the lung tissue is still more friable. The air-cells are densely filled with leucocytes, the fibrin network and the red blood-corpuscles have largely disappeared. A more advanced condition of gray hepatization is that known as *purulent infiltration*, in which the lung tissue

is softer and bathed with a purulent fluid. Small abscess cavities may form, and by their fusion larger ones, though this is a rare event in ordinary pneumonia.

Resolution.—The changes in the exudate which lead to its resolution are due to an autolytic digestion by proteolytic enzymes which are present much more abundantly in gray hepatization than in the preceding stage. The dissolved exudate is for the most part excreted by the kidneys. By following the nitrogen excess in the urine the progress of resolution may be followed and even an estimate formed of the amount of the exudate thus eliminated. In a study from my clinic H. W. Cook found in cases of delayed resolution that the nitrogen excess in the urine (which persisted until the lung was clear) was very large, and he suggests that delayed resolution may really be a matter of continued exudation.

General Details of the Morbid Anatomy.—In 100 autopsies, made by me at the General Hospital, Montreal, in 51 cases the right lung was affected, in 32 the left, in 17 both organs. In 27 cases the entire lung, with the exception, perhaps, of a narrow margin at the apex and anterior border, was consolidated. In 34 cases, the lower lobe alone was involved; in 13 cases, the upper lobe alone. When double, the lower lobes were usually affected together, but in three instances the lower lobe of one and the upper lobe of the other were attacked. In 3 cases, also, both upper lobes were affected. Occasionally the disease involves the greater part of both lungs; thus, in one instance the left organ with the exception of the anterior border was uniformly hepatized, while the right was in the stage of gray hepatization, except a still smaller portion in the corresponding region. In a third of the cases, red and gray hepatization existed together. In 22 instances there was gray hepatization. As a rule the unaffected portion of the lung is congested or œdematous. When the greater portion of a lobe is attacked, the uninvolved part may be in a state of almost gelatinous œdema. The unaffected lung is usually congested, particularly at the posterior part. This, it must be remembered, may be largely due to post mortem subsidence. The uninflamed portions are not always congested and œdematous. The upper lobe may be dry and bloodless when the lower lobe is uniformly consolidated. The average weight of a normal lung is about 600 grams, while that of an inflamed organ may be 1,500, 2,000, or even 2,500 grams.

The bronchi contain, as a rule, at the time of death a frothy serous fluid, rarely the tenacious mucus so characteristic of pneumonic sputum. The mucous membrane is usually reddened, rarely swollen. In the affected areas the smaller bronchi often contain fibrinous plugs, which may extend into the larger tubes, forming perfect casts. The bronchial glands are swollen and may even be soft and pulpy. The pleural surface of the inflamed lung is invariably involved when the process becomes superficial. Commonly, there is only a thin sheeting of exudate, producing slight turbidity of the membrane. The pleura was not involved in only two of the hundred instances. In some cases the fibrinous exudate may form a creamy layer an inch in thickness. A serous exudation of variable amount is not uncommon.

Lesions in Other Organs.—The heart, particularly its right chamber, is distended with firm, tenacious coagula, which can be withdrawn from the vessels as dendritic moulds. In no other acute disease do we meet with coagula

of such solidity. The spleen is often enlarged, though in only 35 of the 100 cases was the weight above 200 grams. The kidneys show parenchymatous swelling, turbidity of the cortex, and, in a very considerable proportion of the cases—25 per cent.—chronic interstitial changes.

Pericarditis was present in 35 of 658 cases in my series (Chatard). *Endocarditis* occurred in 16 of my 100 post mortems. In 5 of these the endocarditis was of the simple character; in 11 the lesions were ulcerative. Of 209 cases of malignant endocarditis which I collected from the literature, 54 occurred in pneumonia. Kanthack found an antecedent pneumonia in 14.2 per cent. of cases of infective endocarditis. In the recent figures collected by E. F. Wells, of 517 fatal cases of acute endocarditis, 22.3 per cent. were in pneumonia. It is more common on the left than on the right side of the heart. Among 658 cases of pneumonia in the Johns Hopkins Hospital endocarditis occurred in 15 (Marshall). *Myocarditis* and fatty degeneration of the heart may be present in protracted cases.

Meningitis, which is not infrequent, may be associated with malignant endocarditis. It was present in 8 of the 100 autopsies. Of 20 cases of meningitis in ulcerative endocarditis 15 occurred in pneumonia. The meningitis is usually of the convex.

Croupous or diphtheritic inflammation may occur in other parts. A *croupous colitis,* as pointed out by Bristowe, is not very uncommon. It occurred in 5 of my 100 post mortems. It is usually a thin, flaky exudation, most marked on the tops of the folds of the mucous membrane. In one case there was a patch of *croupous gastritis,* covering an area 2 by 8 cm., situated to the left of the cardiac orifice.

The liver shows parenchymatous changes, and often extreme engorgement of the hepatic veins.

Symptoms.—Course of the Disease in Typical Cases.—We know but little of the incubation period in lobar pneumonia. It is probably very short. There are sometimes slight catarrhal symptoms for a day or two. As a rule, the disease sets in abruptly with a severe chill, which lasts from fifteen to thirty minutes or longer. In no acute disease is an initial chill so constant or so severe. The patient may be taken abruptly in the midst of his work, or may awaken out of a sound sleep in a rigor. The temperature taken during the chill shows that the fever has already begun. If seen shortly after the onset, the patient has usually features of an acute fever, and complains of headache and general pains. Within a few hours there is pain in the side, often of an agonizing character; a short, dry, painful cough begins, and the respirations are increased in frequency. When seen on the second or third day, the picture in typical pneumonia is more distinctive than that presented by any other acute disease. The patient lies flat in bed, often on the affected side; the face is flushed, particularly one or both cheeks; the breathing is hurried, accompanied often with a short expiratory grunt; the alæ nasi dilate with each inspiration; herpes is usually present on the lips or nose; the eyes are bright, the pupils are often unequal, the expression is anxious, and there is a frequent short cough which makes the patient wince and hold his side. The expectoration is blood-tinged and extremely tenacious. The temperature may be 104° or 105°. The pulse is full and bounding and the pulse-respiration ratio much disturbed. Examination of the lungs shows the physical signs

of consolidation with blowing breathing and fine râles. After persisting for from seven to ten days the crisis occurs, and with a fall in the temperature

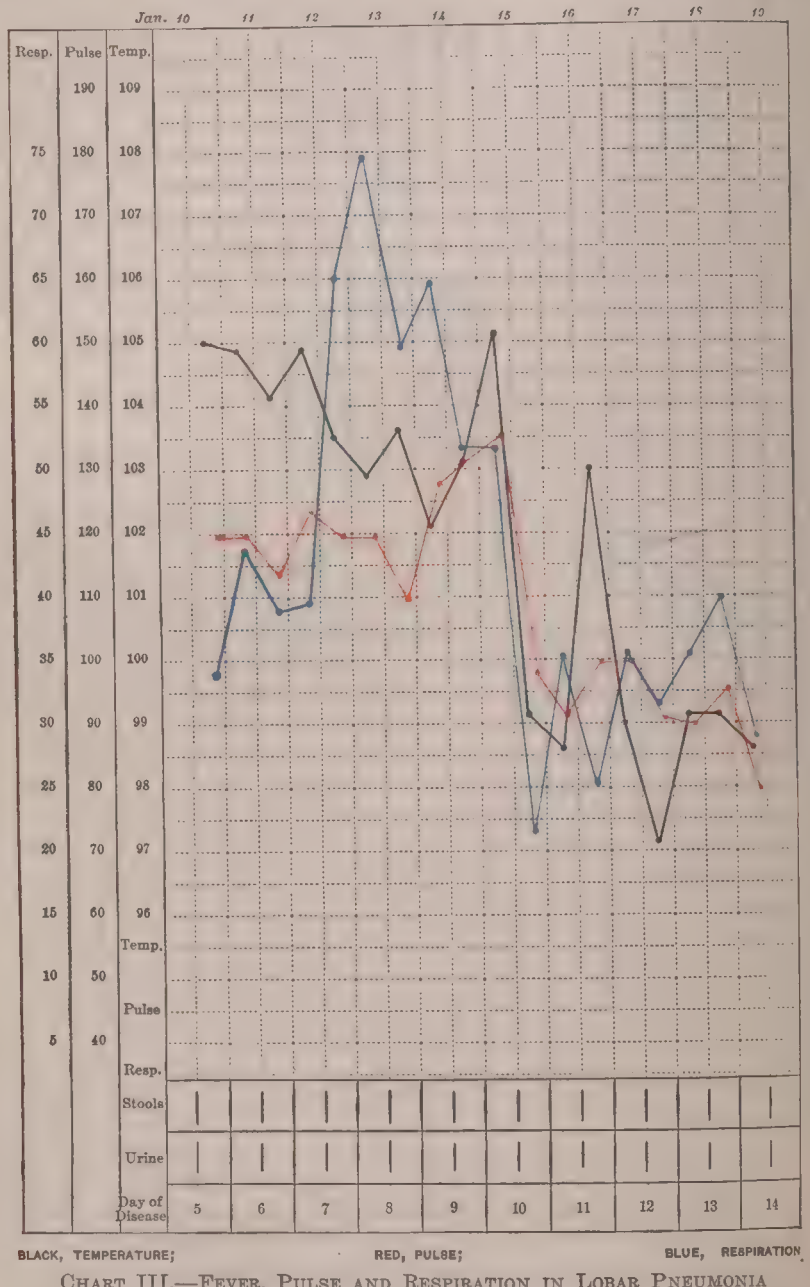

CHART III.—FEVER, PULSE AND RESPIRATION IN LOBAR PNEUMONIA

the patient passes from the condition of extreme distress and anxiety to one of comparative comfort.

SPECIAL FEATURES.—*The fever* rises rapidly, and the height may be 104°

F. or 105° F. within twelve hours. Having reached the fastigium, it is remarkably constant. Often the two-hour temperature chart will not show for two days more than a degree of variation. In children and in cases without chill the rise is more gradual. In old persons and in drunkards the temperature range is lower than in children and in healthy individuals; indeed, one occasionally meets with an afebrile pneumonia.

The Crisis.—After the fever has persisted for from five to nine or ten days there is an abrupt drop, known as the crisis, which is one of the most characteristic features of the disease. The day of the crisis is variable. It is very uncommon before the third day, and rare after the twelfth. I have seen it as early as the third day. From the time of Hippocrates it has been thought to be more frequent on the uneven days, particularly the fifth and seventh; the latter has the largest number of cases (Musser and Norris). A *precritical rise* of a degree or two may occur. In one case the temperature rose from 105° to nearly 107°, and then in a few hours fell to normal. Not even after the chill in malarial fever do we see such a prompt and rapid drop in the temperature. The usual time is from five to twelve hours, but often in an hour there may occur a fall of six or eight degrees (S. West). The temperature may be subnormal after the crisis, as low as 96° or 97°. Usually there is an abundant sweat, and the patient sinks into a comfortable sleep. The day after the crisis there may be a slight post-critical rise. A *pseudo-crisis* is not very uncommon, in which on the fifth or sixth day the temperature drops from 104° or 105° to 102°, and then rises again. When the fall takes place gradually within twenty-four hours it is called a protracted crisis. If the fever persists beyond the twelfth day, the fall is likely to be by lysis. In children this mode of termination is common, and occurred in one-third of a series of 183 cases reported by Morrill. Occasionally in debilitated individuals the temperature drops rapidly just before death; more frequently there is an ante-mortem elevation. In cases of delayed resolution the fever may persist for six or eight weeks. The crisis, the most remarkable phenomenon of pneumonia, appears to represent the stage of active immunity to the toxin of the pneumococcus. The fever, dyspnœa and the general symptoms disappear when the immunity reaches a certain stage. With the fall in the fever the respirations become reduced almost to normal, the pulse slows, and the patient passes from perhaps a state of extreme hazard and distress to one of safety and comfort, and yet, so far as the physical examination indicates, there is with the crisis no special change in the local condition in the lung. For a study of the problem see Emerson, The Johns Hopkins Hospital Reports, Vol. XV.

Pain.—There is early a sharp, agonizing pain, generally referred to the region of the nipple or lower axilla of the affected side, and much aggravated on deep inspiration and on coughing. It is associated, as Aretæus remarks, with involvement of the pleura. It is absent in central pneumonia, and much less frequent in apex pneumonia. The pain may be severe enough to require a hypodermic injection of morphia. As has been recognized for many years, the pain may be altogether abdominal, either central or in the right iliac fossa, suggesting appendicitis. Crozer Griffith, calling attention to the frequency of the simulation in children, reports 8 cases, and has collected 31 cases

from the literature, many in adults. The operation for appendicitis has been performed.

Dyspnœa is an almost constant feature. Even early in the disease the respirations may be 30 in the minute, and on the second or third day between 40 and 50. The movements are shallow, evidently restrained, and if the patient is asked to draw a deep breath he cries out with the pain. Expiration is frequently interrupted by an audible grunt. At first with the increased respiration there may be no sensation of distress. Later this may be present in a marked degree. In children the respirations may be 80 or even 100. Many factors combine to produce the shortness of breath—the pain in the side, the toxæmia, the fever, and the loss of function in a considerable area of the lung tissue. Sometimes there appear to be nervous factors at work. That it does not depend upon the consolidation is shown by the fact that after the crisis, without any change in the local condition of the lung, the number of respirations may drop to normal. The ratio between the respirations and the pulse may be 1 to 2 or even 1 to 1.5, a disturbance rarely so marked in any other disease.

Cough.—This usually comes on with the pain in the side, and at first is dry, hard, and without any expectoration. Later it becomes very characteristic—frequent, short, restrained, and associated with great pain in the side. In old persons, in drunkards, in the terminal pneumonias, and sometimes in young children, there may be no cough. After the crisis the cough usually becomes much easier and the expectoration more easily expelled. The cough is sometimes persistent, continuous, and by far the most aggravated and distressing symptom of the disease. Paroxysms of coughing of great intensity after the crisis suggest a pleural exudate.

Sputum.—A brisk hæmoptysis may be the initial symptom. At first the sputum may be mucoid, but usually after twenty-four hours it becomes blood-tinged, viscid, and very tenacious. At first quite red from the unchanged blood, it gradually becomes rusty or of an orange yellow. The tenacious viscidity of the sputum is remarkable; it often has to be wiped from the lips of the patient. When jaundice is present it may be green or yellow. In low types of the disease the sputum may be fluid and of a dark brown color, resembling prune juice. The amount is very variable, ranging from 100 to 300 c. c. in the twenty-four hours. In 100 cases in my clinic studied by Emerson, in 16 there was little or no sputum; in 32 it was typically rusty; in 33 blood-streaked; in 3 cases the sputum was very bloody. In children and very old people there may be no sputum whatever. After the crisis the quantity is variable, abundant in some cases, absent in others.

Microscopically, the sputum consists of leucocytes, mucus corpuscles, red blood-corpuscles in all stages of degeneration, and bronchial and alveolar epithelium. Hæmatoidin crystals are occasionally met with. Of micro-organisms the pneumococcus is usually present, and sometimes Friedländer's bacillus, the influenza bacillus, streptococci, both pyogenes and mucosus, and the colon bacillus. Very interesting constituents are small cell moulds of the alveoli and the fibrinous casts of the bronchioles; the latter may be plainly visible to the naked eye, and sometimes may form good-sized dendritic casts. Chemically, the expectoration is particularly rich in calcium chloride.

Physical Signs.—*Inspection.*—The position of the patient is not con-

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stant. He usually rests more comfortably on the affected side, or he is propped up with the spine curved toward it. Orthopnœa is rare.

In a small lesion no differences may be noted between the sides; as a rule, movement is much less on the affected side, which may look larger. With involvement of a lower lobe, the apex on the same side may show greater movement. The compensatory increased movement on the sound side is sometimes very noticeable even before the patient's chest is bared. The intercostal spaces are not usually obliterated. When the cardiac lappet of the left upper lobe is involved there may be a marked increase in the area of visible cardiac pulsation. Pulsation of the affected lung may cause a marked movement of the chest wall (Graves). Other points to be noticed in the inspection are the frequency of the respiration, the action of the accessory muscles, such as the sterno-cleido-mastoids and scaleni, and the dilatation of the nostrils with each inspiration.

Mensuration may show a definite increase in the volume of the side affected, rarely more, however, than 1 or 1½ cm.

Palpation.—The lack of expansion on the affected side is sometimes more readily perceived by touch than by sight. The pleural friction may be felt. ~~On asking the patient to count,~~ the voice fremitus is greatly increased in comparison with the corresponding point on the healthy side. It is to be ~~remembered~~ noted that if the bronchi are filled with thick secretion, or if, in what is known as massive pneumonia, they are filled with fibrinous exudate, the tactile fremitus may be diminished. It is always well to ask the patient to cough before testing the fremitus.

Percussion.—In the stage of engorgement the note is higher pitched and may have a somewhat tympanitic quality, ~~the so-called 'Skoda's resonance.~~ This can often be obtained over the lung tissue just above a consolidated area. L. A. Conner calls attention to a point which all observers must have noticed, that, when the patient is lying on his side, the percussion at the dependent base is "deeper and more resonant than that of the upper side," which by contrast may seem abnormal, and there may even be a faint tubular element added to the vesicular breathing on the compressed side. When the lung is hepatized, the percussion note is dull, the quality varying a good deal from a note which has in it a certain tympanitic quality to one of absolute flatness. There is not the wooden flatness of effusion and the sense of resistance is not so great. During resolution the tympanitic quality of the percussion note usually returns. For weeks or months after convalescence there may be a higher-pitched note on the affected side. Wintrich's change in the percussion note when the mouth is open may be very well marked in pneumonia of the upper lobe. Occasionally there is an almost metallic quality over the consolidated area, and when this exists with a very pronounced amphoric quality in the breathing the presence of a cavity may be suggested. In deep-seated pneumonias there may be for several days no change in the percussion note.

Auscultation.—Quiet, suppressed breathing in the affected part is often a marked feature in the early stage, and is always suggestive. Only in a few cases is the breathing harsh or puerile. Very early there is heard at the end of inspiration the fine crepitant râle, a series of minute cracklings heard close to the ear, and perhaps not audible until a full breath is drawn. This is possibly a fine pleural crepitus, as J. B. Leaming maintained: it is usually

believed to be produced in the air-cells and finer bronchi by the separation of the sticky exudate. In the stage of red hepatization and when dulness is well defined, the respiration is tubular. It is heard first with expiration (a point noted by James Jackson, Jr.), and is soft and of low pitch. Gradually it becomes more intense, and finally presents an intensity unknown in any other pulmonary affection—of high pitch, perfectly dry, and of equal length with inspiration and expiration. It is simply the propagation of the laryngeal and tracheal sounds through the bronchi and the consolidated lung tissue. The permeability of the bronchi is essential to its production. Tubular breathing is absent in the excessively rare cases of massive pneumonia in which the larger bronchi are completely filled with exudation. When resolution begins mucous râles of all sizes can be heard. At first they are small and have been called the *redux-crepitus*. The voice-sounds and the expiratory grunt are transmitted through the consolidated lung with great intensity. This bronchophony may have a curious nasal quality, to which the term ægophony has been given. There are cases in which the consolidation is deeply seated—so-called central pneumonia, in which the physical signs are slight or even absent, yet the cough, the rusty expectoration, and general features make the diagnosis certain.

Circulatory Symptoms.—During the chill the *pulse* is small, but in the succeeding fever it becomes full and bounding. In cases of moderate severity it ranges from 100 to 116. It is not often dicrotic. In strong, healthy individuals and in children there may be no sign of failing pulse throughout the attack. With extensive consolidation the left ventricle may receive a very much diminished amount of blood and the pulse in consequence may be small. In the old and feeble it may be small and rapid from the outset. The pulse may be full, soft, very deceptive, and of no value whatever in prognosis.

Blood Pressure.—During the first few days there is no change. The extent of involvement seems to have no effect upon the peripheral blood pressure. In the toxic cases the pressure may begin to fall early; a drop of 15-20 mm. Hg. is perfectly safe, but a progressive fall indicates the need of stimulation. A sudden drop is rarely seen except just before death. A slow, gradual fall of more than 20 mm. Hg. means cardio-vascular asthenia, and calls for an increase in the stimulation. The crisis has no effect on the blood pressure. G. A. Gibson calls attention to a useful clinical point, that when the blood pressure as expressed in millimeters of Hg. does not fall below the pulse rate expressed in beats per minute, the outlook is good, and the converse is true. The *heart-sounds* are usually loud and clear. During the intensity of the fever, particularly in children, *bruits* are not uncommon both in the mitral and in the pulmonic areas. The second sound over the pulmonary artery is accentuated. Attention to this sign gives a valuable indication as to the condition of the lesser circulation. With distention of the right chambers and failure of the right ventricle to empty itself completely, the pulmonary second sound becomes much less distinct. When the right heart is engorged there may be an increase in the dulness to the right of the sternum. With gradual heart weakness and signs of dilatation the long pause is greatly shortened, the sounds approach each other in tone and have a fetal character (embryocardia).

There may be a sudden early collapse of the heart with very feeble, rapid

But this is not what reliable —

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pulse and increasing cyanosis. I have known this to occur on the third day. Even when these symptoms are very serious recovery may take place. In other instances without any special warning death may occur even in robust, previously healthy men. The heart weakness may be due to paralysis of the vaso-motor centre and consequent lowering of the general arterial pressure. The soft, easily compressed pulse, with the gray, ashy facies, cold hands and feet, the clammy perspiration, and the progressive prostration tell of a toxic

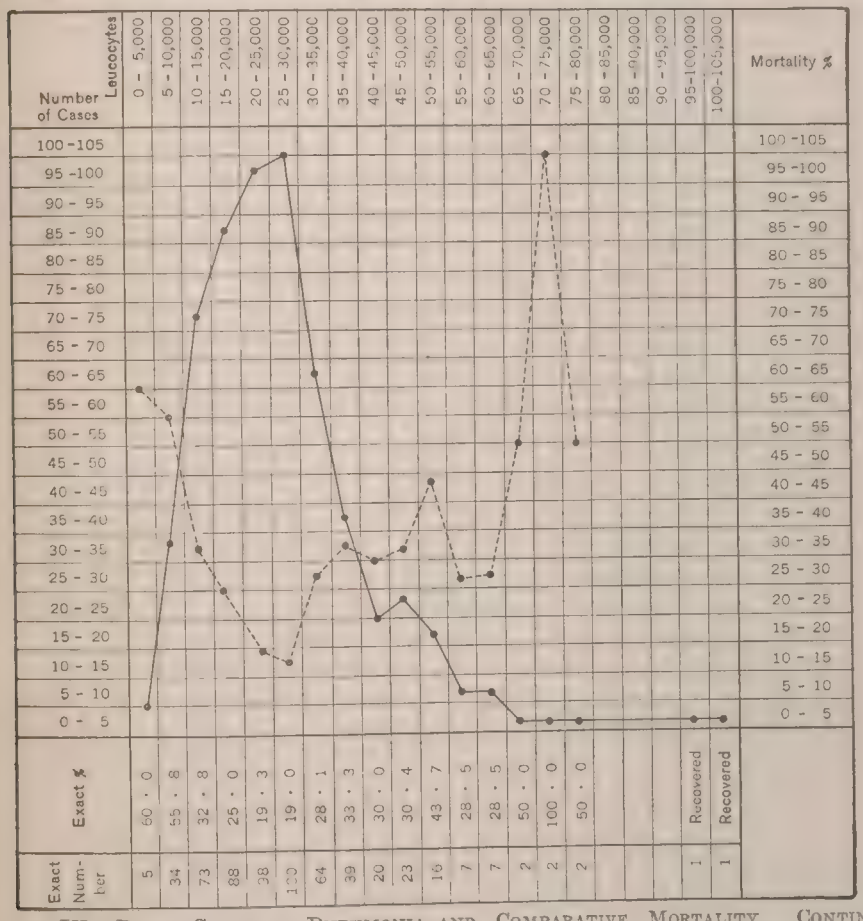

CHART IV.—BLOOD COUNT IN PNEUMONIA AND COMPARATIVE MORTALITY. CONTINUOUS LINE REPRESENTS NUMBER OF CASES OF PNEUMONIA. BROKEN LINE REPRESENTS MORTALITY PERCENTAGE OF SAME.

action on the vaso-motor centres. Endocarditis and pericarditis will be considered under complications.

Blood.—Anæmia is rarely seen. Bollinger has called attention to an oligæmia due to the large amount of exudate. A decrease in the red cells may occur at the time of the crisis. There is in most cases a leucocytosis, which appears early, persists, and disappears with the crisis. The leucocytes may number from 12,000 to 40,000 or even 100,000 per cubic millimetre. The fall in the leucocytes is often slower than the drop in the fever, particularly when resolution is delayed. The annexed chart gives a study of the leuco-

cytes in 582 cases at the Johns Hopkins Hospital by Chatard. More than half of the patients, about 350, had a leucocytosis of between 15,000 and 35,000, and nearly one-third (198) between 20,000 and 30,000. The broken line represents the mortality which is high when the leucocytes are below 10,000, but steadily decreases and is lowest when they are between 20,000 and 30,0000. With the leucocytes between 30,000 and 60,000 the mortality is again higher. The two patients with the highest leucocytosis of the series, 95,000 and 105,000 respectively, recovered. A striking feature in the blood-slide is the richness and density of the fibrin network. This corresponds to the great increase in the fibrin elements, the proportion rising from 4 to 10 parts per thousand. The blood-plates are greatly increased.

Digestive Organs.—The tongue is white and furred, and in severe toxic cases rapidly becomes dry. Vomiting is not uncommon at the onset in children. The appetite is lost. Constipation is more common than diarrhœa. A distressing and sometimes dangerous symptom is meteorism. Fibrinous, pneumococcic exudates may occur in the conjunctivæ, nose, mouth, prepuce, and anus (Cary). The liver may be depressed by the large right lung, or enlarged from the engorged right heart or as a result of the infection. The spleen is usually enlarged, and the edge can be felt during a deep inspiration.

Skin.—Among *cutaneous* symptoms one of the most interesting is the association of herpes with pneumonia. Not excepting malaria, we see labial herpes more frequently in this than in any other disease, occurring, as it does, in from 12 to 40 per cent. of the cases. It is supposed to be of favorable prognosis, and figures have been quoted in proof of this assertion. It may also occur on the nose, genitals, and anus. Its significance and relation to the disease are unknown. At the height of the disease sweats are not common, but at the crisis they may be profuse. Redness of one cheek is a phenomenon long recognized in ~~connection with~~ pneumonia, and is usually on the same side as the disease. A diffuse erythema is occasionally seen, and in rare cases purpura. Jaundice is referred to among the complications.

Urine.—Early in the disease it presents the usual febrile characters of high color, high specific gravity, and increased acidity. A trace of albumin is very common. There may be tube-casts, and in a few instances the existence of albumin, tube-casts, and blood indicates the presence of an acute nephritis. The urea and uric acid are usually increased at first, but may be much diminished before the crisis, to increase greatly with its onset. Robert Hutchison's researches show that a true retention of chlorides within the body takes place, the average amount being about 2 grams daily. It is a more constant feature of pneumonia than of any other febrile disease, and this being the case, a diminution of the chlorides in the urine may be of value in the diagnosis from pleurisy with effusion or empyema. It is to be remembered that in dilatation of the stomach chlorides may be absent. Hæmaturia is a rare complication.

Cerebral Symptoms.—Headache is common. In children convulsions occur frequently at the outset. Apart from meningitis, which will be considered separately, one may group the cases with marked cerebral features into:

First, the so-called cerebral pneumonias of children, in which the disease sets in with a convulsion, and there are high fever, headache, delirium, great irritability, muscular tremor, and perhaps retraction of the head and neck.

There may be small dilatation of the stomach. p. 90

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The diagnosis of meningitis is usually made, and the local affection may be overlooked.

Secondly, the cases with maniacal symptoms. These may occur at the very outset, and I once performed an autopsy on a case in which there was no suspicion whatever that the disease was other than acute mania. The physician should give instructions to the nurses to watch such cases very carefully. On March 22, 1894, a patient who had been doing very well, with the exception of slight delirium, while the orderly was out of the room for a few moments, got up, raised the window, and jumped out, sustaining a fracture of the leg and of the upper lumbar vertebræ, of which he died.

Thirdly, alcoholic cases with the features of delirium tremens. It should be an invariable rule, even if fever be not present, to examine the lungs in a case of *mania a potu*.

Fourthly, cases with toxic features, rather resembling those of uræmia. Without a chill and without cough or pain in the side, a patient may have fever, a little shortness of breath, and then gradually grow dull mentally, and within three days be in a condition of profound toxæmia with low, muttering delirium.

It is stated that apex pneumonia is more often accompanied with severe delirium. Occasionally the cerebral symptoms occur immediately after the crisis. Mental disturbance may persist during and after convalescence, and in a few instances delusional insanity follows, the outlook in which is favorable.

Complications.—Compared with typhoid fever, pneumonia has but few complications and still fewer sequelæ. The most important are the following:

Pleurisy is an inevitable event when the inflammation reaches the surface of the lung, and thus can scarcely be termed a complication. But there are cases in which the pleuritic features take the first place. The exudation may be sero-fibrinous with copious effusion, differing from that of an ordinary acute pleurisy in the greater richness of the fibrin, which may form thick, tenacious, curdy layers. Pneumonia on one side with extensive pleurisy on the other is sometimes a puzzling complication to diagnose, and an aspirating needle may be required to settle the question. *Empyema* is a most common complication occurring in 2.2 per cent. of clinical cases collected by Musser and Norris and in 3.6 per cent. of the Johns Hopkins Hospital series. During the eight years, 1883-'90, there were at Guy's Hospital 7 cases of empyema among 445 cases of pneumonia, while in the eight years, 1891-'98, there were 38 cases among 896 cases of pneumonia (Hale White). Influenza may be responsible for the increase. The pneumococcus is usually present; in a few the streptococcus, in which case the prognosis is not so good. Recurrence of the fever after the crisis or persistence of it after the tenth day, with sweats, leucocytosis, and an aggravation of the cough, are suspicious symptoms. The dulness persists at the base, or may extend. The breathing is feeble and there are no râles. Such a condition may be closely simulated, of course, by a thickened pleura. Exploratory aspiration may settle the question at once. There are obscure cases in which the pus has been found only after operation, as the collection may be very small.

Pericarditis, one of the most serious of complications, was present in 35 of 658 patients in my wards at the Johns Hopkins Hospital (Chatard). It is often a terminal affair and overlooked. The mortality is very high; 31 of the

35 patients died. It was most frequently associated with pneumonia of the right lung. In only three instances was the amount of fluid above 500 c. c. Pleurisy is an almost constant accompaniment, being present in 28 of the 29 autopsies in my series.

Endocarditis.—The valves on the left side are more commonly attacked, and particularly if the seat of arterio-sclerosis. It is especially liable to attack persons with old valvular disease. There may be no symptoms indicative of this complication even in very severe cases. It may, however, be suspected in cases (1) in which the fever is protracted and irregular; (2) when signs of septic mischief arise, such as chills and sweats; (3) when embolic phenomena appear. The frequent complication of meningitis with the endocarditis of pneumonia, which has already been mentioned, gives prominence to the cerebral symptoms in these cases. The physical signs may be very deceptive. There are instances in which no cardiac murmurs have been heard. In others the occurrence under observation of a loud, rough murmur, particularly if diastolic, is extremely suggestive.

Ante-mortem clotting in the heart, upon which the old writers laid great stress, is very rare. *Thrombosis* in the peripheral veins is also uncommon. Three cases occurred at my clinic, which have been reported by Steiner, who was able to collect only 54 cases from the literature. In 35 out of 44 cases which were fully reported, the thrombosis occurred during convalescence. It is almost always in the femoral veins. A rare complication is *embolism* of one of the larger arteries. I saw in Montreal an instance of embolism of the femoral artery at the height of pneumonia, which necessitated amputation at the thigh. The patient recovered. *Aphasia* has been met with in a few instances, setting in abruptly with or without hemiplegia.

Meningitis is perhaps the most serious complication of pneumonia. It varies very much at different times and in different regions. My Montreal experience is rather exceptional, as 8 per cent. of the fatal cases had this complication. In twenty years at the Johns Hopkins Hospital there were 25 cases of pneumococcus meningitis, in 18 of which pneumonia was present. In 16 of the cases the organism was demonstrated in the cerebro-spinal fluid. Endocarditis was present in 7 of the 18 cases. The percentage of meningitis in the pneumonia cases was 2.4, which is lower than the figures of Musser and Norris of 3.5 per cent. in 4,883 autopsies. It usually comes on at the height of the fever, and in the majority of the cases is not recognized unless, ~~as before mentioned,~~ the base is involved, which is not common. Occurring later in the disease, it is more easily diagnosed. The prognosis is bad; all of our patients died. A few instances of recovery are on record.

Peripheral neuritis is a rare complication, of which several cases have been described.

Gastric complications are rare. Fussell has ~~recently~~ drawn attention to the occurrence of acute *dilatation of the stomach.* Persistent vomiting, sudden abdominal distention and collapse are the most common features. A croupous gastritis has ~~already~~ been mentioned. The *croupous colitis* may induce severe diarrhœa.

It is by no means uncommon to have early *pain,* either in the region of the umbilicus or in the right iliac fossa, and a suspicion of appendicitis is aroused; indeed, a catarrhal form of this disease may occur coincidently with

the pneumonia. In other instances so localized may the pain be in the region of the pancreas, associated with meteorism and high fever, that the diagnosis of acute hæmorrhagic pancreatitis is made. Such a case occurred in February, 1905, in the wards of my colleague Dr. Halsted. The patient was admitted in a desperate condition, all the symptoms were abdominal, and the apex pneumonia was not discovered. *Peritonitis* is a rare complication, of which we have had only two or three instances. It is sometimes in the upper peritoneum, and a direct extension through the diaphragm. It is usually in the severer cases and not easy to recognize. In one case, indeed, in which there was a friction along the costal border, which we thought indicated a peritonitis; it was communicated from the diaphragmatic pleura. *Meteorism* is not infrequent, and is sometimes serious. In some cases it may be due to a defect in the mechanical action of the diaphragm, in others to an acute septic catarrh of the bowels, or to a toxic paresis of the walls, occasionally to peritonitis. *Jaundice* occurs with curious irregularity in different outbreaks of the disease. In Baltimore it was more common among the negro patients. It sets in early, is rarely very intense, and has not the characters of obstructive jaundice. There are cases in which it assumes a very serious form. The mode of production is not well ascertained. It does not appear to bear any definite relation to the degree of hepatic engorgement, and it is not always due to catarrh of the ducts. Possibly it may be, in great part, hæmatogenous.

Parotitis occasionally occurs, commonly in association with endocarditis. In children, middle-ear disease is not an infrequent complication.

Bright's disease does not often follow pneumonia.

Arthritis occurred in 5 of 658 cases at the Johns Hopkins Hospital (Howard). It may precede the onset, and the pneumonia, possibly with endocarditis and pleurisy, may occur as a complication. In other instances at the height of an ordinary pneumonia one or two joints may become red and sore. On the other hand, after the crisis has occurred pain and swelling may come on in the joints. It is a serious complication as recovery is often slow and a stiff joint may follow.

Relapse.—There are cases in which from the ninth to the eleventh day the fever subsides, and after the temperature has been normal for a day or two a rise occurs and fever may persist for another ten days or even two weeks. Though this might be termed a relapse, it is more correct to regard it as an instance of an anomalous course of delayed resolution. Wagner, who has studied the subject carefully, says that in his large experience of 1,100 cases he met with only 3 doubtful cases. When it does occur, the attack is usually abortive and mild. In the case of Z. R. (Medical No. J. H. H., 4225), with pneumonia of the right lower lobe, crisis occurred on the seventh day, and after a normal temperature for thirteen days he was discharged. That night he had a shaking chill, followed by fever, and he had recurring chills with reappearance of the pneumonia. In a second case (Medical No. J. H. H., 4538), crisis occurred on the third day, and there was recurrence of pneumonia on the thirteenth day.

Recurrence is more common in pneumonia than in any other acute disease. Rush gives an instance in which there were 28 attacks. Other authorities narrate cases of 8, 10, and even more attacks.

Convalescence in pneumonia is usually rapid, and sequelæ are rare. After

the crisis, sudden death has occurred when the patient has got up too soon. With the onset of fever and persistence of the leucocytosis the affected side should be very carefully examined for pleurisy. With a persistence of the dulness the physical signs may be obscure, but the use of a small exploratory needle will help to clear the diagnosis.

Clinical Varieties.—Local variations are responsible for some of the most marked deviations from the usual type.

Apex pneumonia is said to be more often associated with adynamic features and with marked cerebral symptoms. The expectoration and cough may be slight.

Migratory or *creeping pneumonia*, a form which successively involves one lobe after the other.

Double pneumonia has no peculiarities other than the greater danger connected with it.

Massive pneumonia is a rare form, in which not alone the air-cells but the bronchi of an entire lobe or even of a lung are filled with the fibrinous exudate. The auscultatory signs are absent; there is neither fremitus nor tubular breathing, and on percussion the lung is absolutely flat. It closely resembles pleurisy with effusion. The moulds of the bronchi may be expectorated in violent fits of coughing.

Central Pneumonia.—The inflammation may be deep-seated at the root of the lung or centrally placed in a lobe, and for several days the diagnosis may be in doubt. It may not be until the third or fourth day that a pleural friction is detected, or that dulness or blowing breathing and râles are recognized. I saw in 1898 with Drs. H. Adler and Chew a young, thin-chested girl in whom at the end of the fourth day all the usual symptoms of pneumonia were present without any physical signs other than a few clicking râles at the left apex behind. The thinness of the patient greatly facilitated the examination. The general features of pneumonia continued, and the crisis occurred on the seventh day.

Pneumonia in Infants.—It is sometimes seen in the new-born. In infants it very often sets in with a convulsion. The apex of the lung seems more frequently involved than in adults, and the cerebral symptoms are more marked. The torpor and coma, particularly if they follow convulsions, and the preliminary stage of excitement, may lead to the diagnosis of meningitis. Pneumonic sputum is rarely seen in children.

Pneumonia in the Aged.—The disease may be latent and set in without a chill; the cough and expectoration are slight, the physical signs ill-defined and changeable, and the constitutional symptoms out of all proportion to the extent of the local lesion.

Pneumonia in Alcoholic Subjects.—The onset is insidious, the symptoms masked, the fever slight, and the clinical picture usually that of delirium tremens. The thermometer alone may indicate the presence of an acute disease. Often the local condition is overlooked, as the patient makes no complaint ~~of pain~~, and there may be very little ~~shortness of breath~~, no cough, and no sputum.

Terminal Pneumonia.—The wards and the post mortem room show a very striking contrast in their pneumonia statistics, owing to the occurrence of what may be called terminal pneumonia. During the winter months

x-rays -

Impressum

patients with chronic pulmonary tuberculosis, arterio-sclerosis, heart disease, Bright's disease, and diabetes are not infrequently carried off by a pneumonia which may give few or no signs of its presence. In the Johns Hopkins Hospital series of 658 cases, there were 35 cases of this variety, 20 of which were associated with cardio-vascular and 14 with renal disease. It is nearly always of the lobar form. There may be a slight elevation of temperature, with increase in the respirations, but the patient is near the end and perhaps not in a condition in which a thorough physical examination can be made. In our series the right lung was involved in 19 cases and 9 had a low leucocyte count. In diabetic patients the disease often runs a rapid and severe course, and may end in abscess or gangrene.

Secondary Pneumonia.—These are met with chiefly in the specific fevers, particularly diphtheria, typhoid fever, typhus, influenza, and the plague. Anatomically, they rarely present the typical form of red or gray hepatization. The surface is smoother, not so dry, and it is often a pseudo-lobar condition, a consolidation caused by closely set areas of lobular involvement. Histologically, they are characterized in many instances by a more cellular, less fibrinous exudate, which may also infiltrate the alveolar walls. Bacteriologically, the pneumococcus may be the dominant organism; but Friedländer's bacillus, streptococci, staphylococci, the influenza and colon bacillus have been found.

The symptoms of the secondary pneumonias often lack the striking definiteness of the primary croupous pneumonia. The pulmonary features may be latent or masked altogether. There may be no cough and only a slight increase in the number of respirations. The lower lobe of one lung is most commonly involved, and the physical signs are obscure and rarely amount to more than impaired resonance, feeble breathing, and a few crackling râles.

Epidemic pneumonia has already been referred to. It is, as a rule, more fatal, and often displays minor complications which differ in different outbreaks. In some the cerebral manifestations are very marked; in others, the cardiac; in others again, the gastro-intestinal.

Larval Pneumonia.—Mild, abortive types are seen, particularly in institutions when pneumonia is prevailing extensively. A patient may have the initial symptoms of the disease, a slight chill, moderate fever, a few indefinite local signs, and herpes. The whole process may only last for two or three days; some authors recognize even a one-day pneumonia.

Asthenic, Toxic, or Typhoid Pneumonia.—The toxæmic features dominate the scene throughout. The local lesions may be slight in extent and the subjective phenomena of the disease absent. The nervous symptoms usually predominate. There are delirium, prostration, and early weakness. Very frequently there is jaundice. Gastro-intestinal symptoms may be present, particularly diarrhœa and meteorism. In such a case, seen about the end of the first week, it may be difficult to say whether the condition is one of asthenic pneumonia or one of typhoid fever which has set in with early localization in the lung. Here the Widal reaction and cultures from the blood are important aids. The pneumococcus may sometimes be isolated from the blood. Possibly, too, there is a mixed infection, and the streptococcus pyogenes may be in large part responsible for the toxic features of the disease.

Association of Pneumonia with Other Diseases.—(*a*) *With Malaria.*—A malarial pneumonia is described by many observers and thought to be

particularly prevalent in some parts of the United States. One hears of it, indeed, even where true malaria is rarely seen. Pneumonia is a common disease in the tropics and often attacks the subjects of malaria. The prognosis is bad in the æstivo-autumnal infections. A special form of pneumonia due to the malarial parasite is unknown. Yet there are cases reported by Craig and others in which in an acute malarial infection the features suggest pneumonia at the onset, but the parasites are found in the blood, and under the use of quinine the fever drops rapidly and the pneumonia symptoms clear up. Such a case as the following we see occasionally: A patient was admitted, March 16, 1894, with tertian malarial fever. The lungs were clear. A pneumonia began thirty-six hours after admission. Quinine was given that evening, and the malarial organisms rapidly disappeared from the blood. There was successive involvement of the right lower, the middle, and the left lower lobe. The temperature fell by crisis on the 24th, and there were no features in the disease whatever suggestive of malaria. In other instances we have found a chill in the course of an ordinary pneumonia to be associated with a malarial infection, and quinine has rapidly and promptly caused the disappearance of the parasites from the blood.

(*b*) *Pneumonia and Acute Arthritis.*—We have already spoken under complications of this association, which is more frequently seen in children.

(*c*) *Pneumonia and Tuberculosis.*—Many subjects of chronic pulmonary tuberculosis die of an acute croupous pneumonia. A point to be specially borne in mind is the fact that acute tuberculous pneumonia may set in with all the features and physical signs of fibrinous pneumonia.

For the consideration of the association of pneumonia with typhoid fever and influenza, the reader is referred to the sections on those diseases.

Post-operation Pneumonia.—Before the days of anæsthesia, lobar pneumonia was a well-recognized cause of death after surgical injuries and operations. Norman Cheevers, in an early number of the Guy's Hospital Reports, calls attention to it as one of the most frequent causes of death after surgical procedures, and Erichsen states that of 41 deaths after surgical injuries 23 cases showed signs of pneumonia. In the statistics collected by Homans the mortality due to lung complications after laparotomies ranged from 0.56 to 12.5. Operations on the stomach seem to be peculiarly liable to be followed by pneumonia. The low figure, 0.56, in Krönlein's clinic may be attributed to the use of ether by the open method, to the absence of all preparation on the table and to shortening as much as possible the period of anæsthesia. The cases may be divided into three groups: (1) Inhalation or anæsthesia pneumonia, characterized by areas of broncho-pneumonia or a lobar pneumonia. (2) Hypostatic pneumonia due to enfeebled circulation. (3) Embolic cases with sudden onset. The route may be lymphatic or through the veins.

Anæsthesia Pneumonia.—The cases appear to be quite as frequent after chloroform as after ether. The vapor of the anæsthetic may itself have a damaging influence on the bronchial and alveolar epithelium, but a more important influence is the aspiration of mucus and saliva into the air passages during the anæsthesia. Neuwerek, and subsequently Whitney, have suggested thorough disinfection of the mouth and throat before operation. Pneumonia is the most frequent complication, next a diffuse bronchitis. W. Pasteur has

is a unique specialist museum.

called attention to a condition of massive collapse of the lungs due to deflation of the lower lobes, owing to imperfect action or paralysis of the diaphragm. He has published the statistics of lung complications at the Middlesex Hospital; following 3,559 abdominal operations there were 201 pulmonary complications, with 45 deaths. Among these pneumonia heads the list with 88 cases and 31 deaths. The complications are much more numerous in operations above the umbilicus. The pneumonia is usually patchy, involving both lungs; sometimes it is lobar, and as a rule the signs are well marked within the first two days after operation. The collapse, to which Pasteur calls attention, may involve both lower lobes or only one lung, and it may simulate pneumonia very closely, or may initiate it. When unilateral, the mediastinum and heart are drawn towards the affected side. It may come on with great suddenness, and when widespread it may prove fatal.

Delayed Resolution in Pneumonia.—The lung is restored to its normal state by the liquefaction and absorption of the exudate. There are cases in which resolution takes place rapidly without any increase in (or, indeed, without any) expectoration; on the other hand, during resolution it is not uncommon to find in the sputum the little plugs of fibrin and leucocytes which have been loosened from the air-cells and expelled by coughing. A variable time is taken in the restoration of the lung. Sometimes within a week or ten days the dulness is greatly diminished, the breath-sounds become clear, and, so far as physical signs are any guide, the lung seems perfectly restored. Delayed resolution occurs in from 3 to 4 per cent. of cases. Of 40 cases at the Johns Hopkins Hospital studied by McCrae, 33 were males and 7 females; 23 of the patients were negroes, a very high incidence. The lower lobe is most frequently involved, 37 cases in this series, usually the right one and as a rule only one lobe. The duration was to the fourth week 5 cases, fifth week 10 cases, sixth week 4 cases, ninth week 3 cases, tenth, eleventh and twelfth weeks each one case. I saw a patient in whom the left lung, except a small portion of the upper lobe, remained solid for eleven weeks and then cleared perfectly.

Clinically, there are several groups of cases: First, those in which the crisis occurs naturally, the temperature falls and remains normal; but the local features persist—well-marked flatness with tubular breathing and râles. Resolution may occur very slowly and gradually, taking from two to three weeks. In a second group of cases the temperature falls by lysis, and with the persistence of the local signs there is slight fever, sometimes sweats and rapid pulse. The condition may persist for three or four weeks and during all this time there may be little or no sputum. The practitioner is naturally much exercised, and he dreads lest tuberculosis should supervene. In a third group the crisis occurs or the fever falls by lysis; but the consolidation persists, and there may be intense bronchial breathing, with few or no râles, or the fever may recur and the patient may die exhausted.

Termination in Chronic Pneumonia.—The exudate may organize and the alveolar walls thicken with the production gradually of a chronic interstitial or fibroid pneumonia. In one of my pneumonia autopsies on a patient aged 58, dead on the thirty-second day from the initial chill, the right lung was solid and the cut surface grayish in color with a smooth, translucent appearance. This termination is most frequently seen as a sequence of delayed

resolution in debilitated subjects. In a recent study Milne found 10 instances of organization of the exudate among 150 fatal cases. The shortest duration in the series was twenty-three days.

Ordinary fibrinous pneumonia never terminates in tuberculosis. The instances of caseous pneumonia and softening which have followed an acute pneumonic process have been from the outset tuberculous.

Termination in Abscess.—This occurred in 4 of my 100 autopsies. Usually the lung breaks down in limited areas and the abscesses are not large, but they may fuse and involve a considerable proportion of a lobe. The condition is recognized by the sputum, which is usually abundant and contains pus and elastic tissue, sometimes cholesterin crystals and hæmatoidin crystals. The cough is often paroxysmal and of great severity; usually the fever is remittent, or in protracted cases intermittent in character, and there may be pronounced hectic symptoms. When a case is seen for the first time it may be difficult to determine whether it is one of abscess of the lung or a local empyæma which has perforated the lung.

Gangrene.—This is most commonly seen in old debilitated persons. It was present in 3 of my 100 autopsies. It very often occurs with abscess. The gangrene is associated with the growth of the saprophytic bacteria on a soil made favorable by the presence of the pneumococcus or the streptococcus. Clinically, the gangrene is rendered very evident by the horribly fetid odor of the expectoration and its characteristic features. In some instances the gangrene may be found post mortem when clinically there has not been any evidence of its existence.

Prognosis.—Pneumonia is one of the most fatal of all acute diseases, killing more than diphtheria, and outranking even consumption as a cause of death.

The statistics of my clinic at the Johns Hopkins Hospital from 1889 to 1905 have been analyzed by Chatard. There were 658 cases with 200 deaths, a mortality of 30.4 per cent. Excluding 35 cases of terminal pneumonia the percentage is 26.4. The death rate among 245 negroes was very little above that of the whites. Greenwood and Candy in a study of the pneumonia statistics at the London Hospital from 1854-1903, a total of 5,097 cases, conclude that the fatality of the disease has not appreciably changed in this period. In comparing the collected figures of these authors with those from other institutions, there is an extraordinary uniformity in the mortality rate. Between the ages of 21-30 the mortality is everywhere about 20 per cent.; between the ages of 31-40, 30 per cent.; and then after each decade it rises, until above the age of 60 more than one-half of the persons attacked die.

The mortality in private practice varies greatly. R. P. Howard treated 170 cases with only 6 per cent. of deaths. Fussell has reported 134 cases with a mortality of 17.9 per cent. The mortality in children is sometimes very low. Morrill has reported 6 deaths in 123 cases of frank pneumonia. On the other hand, Goodhart had 25 deaths in 120 cases.

The following are among the circumstances which influence the prognosis:

Age.—As Sturges remarks, the old are likely to die, the young to recover. Under one year it is more fatal than between two and five. Of 50 cases under 10 years of age 4 died; of 119 cases under 20, 16 died (Chatard). Above sixty

tuberculosis. in urine ?

Det. of type. –
high grade of blood infection of bad sinus.
heavy precipitin reaction in urine

tuberculosis

the death rate is very high, amounting to 60 or 80 per cent.; 33 of 44 cases in my series. From the reports of its fatality in some places, one may say that to die of pneumonia is almost the natural end of old people.

Previous habits of life and the condition of bodily health at the time of the attack form the most important factors in the prognosis ~~of pneumonia.~~ In analyzing a series of fatal cases one is very much impressed with the number of cases in which the organs show signs of degeneration. In 25 of my 100 autopsies at the Montreal General Hospital the kidneys showed extensive interstitial changes. Individuals debilitated from sickness or poor food, hard drinkers, and that large class of hospital patients, composed of robust-looking laborers between the ages of forty-five and sixty, whose organs show signs of wear and tear, and who have by excesses in alcohol weakened the reserve power, fall an easy prey to the disease. Very few fatal cases occur in robust, healthy adults. Some of the statistics given by army surgeons show better than any others the low mortality from pneumonia in healthy picked men. The death rate in the German army in over 40,000 cases was only 3.6 per cent.

Certain *complications* and terminations are particularly serious. The meningitis of pneumonia is almost always fatal. Endocarditis is extremely grave, ~~much~~ more so than pericarditis. Much stress has been laid ~~of late~~ upon the factor of *leucocytosis* as an element in the prognosis. A very slight or complete absence of a leucocytosis is rightly regarded as very unfavorable.

Toxæmia is the important prognostic feature, ~~in the disease~~, to which in a majority of the cases the degree of pyrexia and the extent of consolidation are entirely subsidiary. It is not at all proportionate to the degree of lung involved. A severe and fatal toxæmia may occur with the consolidation of only a small part of one lobe. On the other hand, a patient with complete solidification of one lung may have no signs of a general infection. The question of individual resistance seems to be the most important one, and one sees robust-looking individuals fatally stricken within a few days.

Death is rarely due to direct interference with the function of respiration, even in double pneumonia. Sometimes it seems to be caused by the extensive involvement with œdema of the other parts of the lungs, an engorgement with progressive weakness of the right heart. But death is ~~most~~ frequently due to the action of the poisons on the vaso-motor centres, with progressive lowering of the blood pressure. This is a much more serious factor than direct weakness of the heart muscle itself.

Diagnosis.—No disease is more readily recognized in a large majority of the cases. The external characters, the sputum, and the physical signs combine to make one of the clearest of clinical pictures. The ordinary lobar pneumonia of adults is rarely overlooked. Errors are particularly liable to occur in the intercurrent pneumonias, in those complicating chronic affections, and in the disease as met with in children, the aged, and drunkards. ~~Tubercular~~ pneumonic phthisis is frequently confounded with pneumonia. Pleurisy with effusion is not often mistaken except in children. The diagnostic points will be referred to under pleurisy.

In diabetes, ~~Bright's disease~~, chronic heart-disease, pulmonary ~~phthisis~~, and cancer, an acute pneumonia often ends the scene, and is frequently overlooked. In these cases the temperature is perhaps the best index, and should, more particularly if cough occurs, lead to a careful examination of the lungs.

The absence of expectoration and of pulmonary symptoms may make the diagnosis very difficult.

In children there are two special sources of error; the disease may be entirely masked by the cerebral symptoms and the case mistaken for one of meningitis. It is remarkable in these cases how few indications there are of pulmonary trouble. The other condition is pleurisy with effusion, which in children often has deceptive physical signs. The breathing may be intensely tubular and tactile fremitus may be present. The exploratory needle is sometimes required to decide the question. In the old and debilitated a knowledge that the onset of pneumonia is insidious, and that the symptoms are ill-defined and latent, should put the practitioner on his guard and make him very careful in the examination of the lungs in doubtful cases. In chronic alcoholism the cerebral symptoms may completely mask the local process. As mentioned, the disease may assume the form of violent mania, but more commonly the symptoms are those of delirium tremens. In any case, rapid pulse, rapid respiration, and fever are symptoms which should invariably excite suspicion of ~~inflammation of the lungs~~. Under cerebro-spinal meningitis will be found the points of differential diagnosis between pneumonia and that disease.

Pneumonia is rarely confounded with pulmonary tuberculosis, but to differentiate acute ~~tuberculo-~~pneumonic ~~ph~~thisis is often difficult. The attack may set in with a chill. It may be impossible to determine which condition is present until softening occurs and elastic tissue and tubercle bacilli appear in the sputum. A similar mistake is sometimes made in children. With typhoid fever, pneumonia is not infrequently confounded. There are instances of pneumonia with the local signs well marked in which the patient rapidly sinks into what is known as the typhoid state, with dry tongue, rapid pulse, and diarrhœa. Unless the case is seen from the outset it may be very difficult to determine the true nature of the malady. On the other hand, there are cases of typhoid fever which set in with symptoms of lobar pneumonia—the so-called pneumo-typhus. It may be impossible to make a differential diagnosis in such a case unless the characteristic eruption occurs, a blood culture is positive, or the Widal reaction is given.

Prophylaxis.—We do not know the percentage of individuals who harbor the pneumococcus normally in the secretions of the mouth and throat. In a great majority of cases it is an auto-infection, and the lowered resistance due to exposure or to alcohol, or a trauma or anæsthetization, simply furnishes conditions which favor the spread and growth of an organism already present. Individuals who have already had pneumonia should be careful to keep the teeth in good condition, and the mouth and throat in as healthy a state as possible. Antiseptic mouth washes may be used.

We know practically nothing of the conditions under which the pneumococcus lives outside the body, or how it gains entrance in healthy individuals. The sputum of each case should be very carefully disinfected. In institutions the patients should be isolated.

Treatment.—Pneumonia is a self-limited disease, which can neither be aborted nor cut short by any known means at our command. Even under the most unfavorable circumstances it may terminate abruptly and naturally. So also, under the favoring circumstances of good nursing and careful diet,

Vaccination may be performed at

Serum for Typhoid. typhoid must be det. prophylactic effect no value.

sd. hypodermically - 75-100 cc. in fatty tissue and salt soln.

Rpt. 2-3 doses. - repeat if temp. rises. sd. be taken 5-6

Reactions. Toxic.

B. Inject a minute amt. into skin.

If sensitive in 1 hr. local oedema redness

2. Small amt. + then gradually ——— of serum 15 min. for first 15cc,

(Colic give intestinal. ½-1 cc. of serum serum

Bacillus tuberculosis.

the experience of many physicians in different lands has shown that pneumonia runs its course in a definite time, terminating sometimes spontaneously on the third or the fifth day, or continuing until the tenth or twelfth.

There is no specific treatment for pneumonia and no drug which can cut short an attack. The young practitioner should bear in mind that patients are more often damaged than helped by the promiscuous drugging which is still only too prevalent.

(*a*) General Management of a Case.—The same careful hygiene of the bed and of the sick-room should be carried out as in typhoid fever. Everything should be done to make the patient comfortable and to save him exertion. Whenever possible the patient should be in the open air. In cold weather he should have sufficient covering to keep him warm, but should not be overburdened by a heavy weight of clothes. A blanket and rubber sheet, under the mattress, which can be folded up over the bed prevent chilling from below. A hot-water bag should be kept at the feet. The patient is brought indoors when necessary for hydrotherapy. For the heavy flannel undershirts should be substituted a thin, light flannel jacket, open in front, which enables the physician to make his examinations without unnecessarily disturbing the patient. If the patient is indoors the room should be bright and light, letting in the sunshine if possible, and thoroughly well ventilated. Only one or two persons should be allowed in the room at a time. Even when not called for on account of the high fever, the patient should be carefully sponged each day with tepid water. This should be done with as little disturbance as possible. Special care should be taken to keep the mouth and nose clean.

(*b*) Diet.—Plain water, a pleasant table water, or lemonade should be given freely. When the patient is delirious the water should be given at fixed intervals and by the bowel or by infusion if it is not taken by mouth. The food should be liquid, consisting chiefly of milk, either alone or, better, mixed with food prepared from some one of the cereals, and eggs, either soft boiled or raw. Carbohydrate, as milk sugar, can be added to each feeding of milk, and as cane sugar to lemonade.

(*c*) Bowels.—At the onset it is well to give a calomel and saline purge. The bowels can be kept open by salines or enemata. Drastic purgation is not advisable. It is important to prevent *meteorism*, if possible, by care in the diet, giving water freely and preventing constipation. If present, measures for relief should be begun at once. Turpentine stupes, turpentine (ʒ ss, 15 c. c.) added to an enema, and the use of the rectal tube, are helpful. Strychnine hypodermically is also useful. If the stomach is distended, a stomach tube should be passed.

(*d*) Bleeding.—The reproach of Van Helmont, that "a bloody Moloch presides in the chairs of medicine," can not be brought against this generation of physicians. Before Louis' iconoclastic paper on bleeding in pneumonia it would have been regarded as almost criminal to treat a case without venesection. We employ it nowadays much more than we did a few years ago, but more often late in the disease than early. To bleed at the very onset in robust, healthy individuals in whom the disease sets in with great intensity and high fever is, I believe, a good practice. Late in the course marked dilatation of the right heart is the common indication. The quantity of blood removed must be decided by the effect; small amounts are often sufficient.

(*e*) ~~Antipneumococcic~~ Serum.—Anders' analyses of the reported cases do not give a very favorable impression of the value of the serums at present in use. None of these has proved its value. Nor has the vaccine treatment been shown to be of positive worth.

(*f*) Hydrotherapy.—This—internal and external—is our principal means of combatting toxæmia and circulatory failure. Cold sponging is usually the best measure, done every three hours and with the least possible disturbance of the patient. With marked toxæmia or hyperpyrexia a bath at 80° with constant friction may be given for five minutes if it does not increase distress or dyspnœa. The application of linen compresses covered by flannel is an excellent measure. They should be cut to the size of the body, in the shape of a jacket, with the opening at one side instead of in the front, which can be applied from the side of the body with the patient turned, and fastened over the other shoulder and in the axilla. They should be wrung out of water at 50° to 60° and be changed every hour. The compress should cover the thorax and upper abdomen. A large flat ice bag may be kept to the side or back constantly, unless it causes distress. Probably the best effect of hydrotherapy is its effect on the vaso-motor system.

(*g*) Symptomatic Treatment.—(1) *To Relieve the Pain.*—The stitch in the side at onset, which is sometimes so agonizing, is best relieved by a hypodermic injection of a quarter of a grain of morphia. When the pain is less intense and diffuse over one side, the Paquelin cautery applied lightly is very helpful, but the ice bag is usually efficacious. When the disease is fairly established the pain is not, as a rule, distressing, except when the patient coughs, and for this codeia may be used in half-grain doses, or morphia given hypodermically (gr. 1/12 to 1/6), according to the patient's needs. Hot poultices, formerly so much in use, relieve the pain, though not more than the cold applications. For children they are often preferable.

(2) *To Combat the Toxæmia.*—Abundance of water should be given to promote the flow of urine, and the saline infusion seems to act helpfully in this way, but care must be taken not to give too large an amount if the circulation is failing; 500 c. c. is usually sufficient. External hydrotherapy should be kept up actively. ~~Alcohol is generally advisable, best as whisky in amounts of four to twelve ounces in the twenty-four hours.~~ The bowels should be kept freely open by saline laxatives.

(3) An all-important indication is *to support the circulation.* Hydrotherapy and keeping the patient out of doors are of great value for this. Mechanical disturbance, as from meteorism, should be prevented if possible. Drugs should not be given in any routine way and not until they are required. Strychnine is useful ~~(also for its effects on the respiratory centre). It~~ should be given hypodermically and in full doses (gr. 1/40 to 1/20 and even gr. 1/10 for short periods) every two or three hours. Digitalis can be given by mouth as the infusion (℥ ii, 8 c. c.), the tincture (♏ xv, 1 c. c.), or digitalin intramuscularly (gr. 1/30) every four hours. For severe circulatory failure, camphor gr. ii, 0.13 gm. (dissolved in m x of olive oil) hypodermically, digitalin (gr. 1/30) hypodermically, and caffeine (sodiobenzoate) gr. v (0.3 gm.) hypodermically are useful. An injection of hot saline solution given high in the bowel or a saline infusion is helpful.

(4) *Respiratory Tract.*—The most comfortable position, avoidance of ex-

x. rayo.

ertion, and abundance of fresh air are important aids in preventing dyspnœa. Pain should be relieved as much as possible. The value of the administration of oxygen is doubtful. If used, it should be given very slowly and through a funnel held over the mouth and nose. The effect is the best guide as to its continuance. Expectorant drugs are not indicated and often upset the stomach. When the cough is severe it is well to give sedatives, of which codeia (gr. 1/4 to 1/2) or heroin (gr. 1/20 to 1/10) are the best. Morphia in small doses may be required, but these drugs should be given only when necessary. For *œdema* of the lungs strychnine (gr. 1/20) and atropine (gr. 1/100) should be given hypodermically. Venesection is advisable if the right heart be dilated.

(5) *Nervous System.*—The patient with delirium should be constantly watched. An ice bag to the head and frequent ice packs or cold sponges are useful. *Sleep* is important for every patient and the need for this is often forgotten. While such drugs as the bromides and chloral hydrate may be effectual, it is wiser, as a rule, to give morphia hypodermically in a sufficient dose (gr. 1/6 to 1/4) to secure rest and sleep.

(6) *Crisis.*—As this approaches constant watch should be kept for signs of collapse. If sweating is profuse and the patient feeble, atropine (gr. 1/100) should be given hypodermically.

(*h*) Treatment of Complications.—If the fever persists it is important to look out for pleurisy, particularly for the meta-pneumonic empyema. The exploratory needle should be used if necessary. A sero-fibrinous effusion should be aspirated, a purulent opened and drained. In a complicating pericarditis with a large effusion aspiration may be necessary. Delayed resolution is a difficult condition to treat. Fibrolysin, 2.5 c. c. every other day, has been used successfully in a few cases (Crofton). The use of the X-rays is perhaps the most effective treatment. but tuberculin should be included.

(*i*) Convalescence.—The diet should be increased as rapidly as possible, the patient kept out of doors and after an ordinary attack allowed up in about a week. If the heart has suffered rest should be more prolonged.

B. BRONCHO-PNEUMONIA

(*Lobular Pneumonia, Capillary Bronchitis*)

Definition.—A bacterial infection of the finer bronchi and their related lobules.

The process begins with inflammation of the bronchioles and smaller bronchi, a capillary bronchitis, which extends to the alveoli and the whole lobule or a group of lobules becomes filled with exudate, cellular and hæmorrhagic but distinctly less fibrinous than in lobar pneumonia.

Etiology.—Broncho-pneumonia occurs either as a primary or as a secondary affection. The relative frequency in 443 cases is thus given by Holt: Primary, without previous bronchitis, 154; secondary to bronchitis of the larger tubes, 41; to measles, 89; to whooping-cough, 66; to diphtheria, 47; to scarlet fever, 7; to influenza, 6; to varicella, 2; to erysipelas, 2; and to acute ileo-colitis, 19. The proportion of primary to secondary forms as shown in this list is probably too low.

Primary acute broncho-pneumonia, like the lobar form, attacks chil-

of

dren in good health, usually under two years. The etiological factors are very much those of ordinary pneumonia, and probably the pneumococcus is more often associated with it.

SECONDARY BRONCHO-PNEUMONIA occurs in two great groups: (*a*) As a sequence of the infectious fevers—measles, diphtheria, influenza, whooping-cough, scarlet fever, and, less frequently smallpox, erysipelas, and typhoid fever. In children it forms the most serious complication of these diseases, and in reality causes more deaths than are due directly to the fevers. In large cities it ranks next in fatality to infantile diarrhœa. Following, as it does, the contagious diseases which principally affect children, we find that a large majority of cases occur during early life. According to Morrill's Boston statistics, it is most fatal during the first two years of life. The number of cases in a community increases or decreases with the prevalence of measles, scarlet fever, and diphtheria. It is most prevalent in the winter and spring months. In the febrile affections of adults broncho-pneumonia is not very common. Thus in typhoid fever it is not so frequent as lobar pneumonia, though isolated areas of consolidation at the bases are by no means rare in protracted cases of this disease. In old people it may follow debilitating causes of any sort, and is met with in the course of chronic Bright's disease and various acute and chronic maladies.

(*b*) In the second division of this affection are embraced the cases of so-called aspiration or deglutition pneumonia. Whenever the sensitiveness of the larynx is benumbed, as in the coma of apoplexy or uræmia, minute particles of food or drink are allowed to pass the *rima*, and, reaching finally the smaller tubes, excite an intense inflammation similar to the vagus pneumonia which follows the section of the pneumogastrics in the dog. Cases are very common after operations about the mouth and nose, after tracheotomy, and in cancer of the larynx and œsophagus. The aspirated particles in some instances induce such an intense broncho-pneumonia that suppuration or even gangrene supervenes. The ether pneumonia, already described, is often lobular in type.

An aspiration broncho-pneumonia may follow hæmoptysis, the aspiration of material from a bronchiectatic cavity, and occasionally the material from an empyema which has ruptured into the lung. A common and fatal form of broncho-pneumonia is that excited by the tubercle bacillus.

Among general predisposing causes may be mentioned age. As just noted, it is prone to attack infants, and a majority of cases of pneumonia in children under five years of age are of this form. Of 370 cases in children under five years of age, 75 per cent. were broncho-pneumonia (Holt). At the opposite extreme of life it is also common, in association with influenza and with various debilitating circumstances and with the chronic diseases incident to the old. In children, rickets and diarrhœa are marked predisposing causes, and broncho-pneumonia is one of the most frequent post mortem lesions in infants' homes and foundling asylums. The disease prevails most extensively among the poorer classes.

Morbid Anatomy.—On the pleural surfaces, particularly toward the base, are seen depressed bluish or blue-brown areas of collapse, between which the lung tissue is of a lighter color. Here and there are projecting portions over which the pleura may be slightly turbid or granular. The lung is fuller and

nephritis

firmer than normal, and, though in great part crepitant, there can be felt in places throughout the substance solid, nodular bodies. The dark depressed areas may be isolated or a large section of one lobe may be in the condition of collapse. Gradual inflation by a blow-pipe inserted in the bronchus will distend a great majority of these collapsed areas. On section, the general surface has a dark reddish color and usually drips blood. Projecting above the level of the section are lighter red or reddish-gray areas representing the patches of broncho-pneumonia. These may be isolated and separated from each other by tracts of uninflamed tissue or they may be in groups; or the greater part of a lobe may be involved. Study of a favorable section of an isolated patch shows: (*a*) A dilated central bronchiole full of tenacious purulent mucus. A fortunate section parallel to the long axis may show a racemose arrangement—the alveolar passages full of muco-pus. (*b*) Surrounding the bronchus for from 3 to 5 mm. or even more, an area of grayish-red consolidation, usually elevated above the surface and firm to the touch. Unlike the consolidation of lobar pneumonia, it may present a perfectly smooth surface, though in some instances it is distinctly granular. In a late stage of the disease small grayish-white points may be seen, which on pressure may be squeezed out as purulent droplets. A section in the axis of the lobule may present a somewhat grape-like arrangement, the stalks and stems representing the bronchioles and alveolar passages filled with a yellowish or grayish-white pus, while surrounding them is a reddish-brown hepatized tissue. (*c*) In the immediate neighborhood of this peribronchial inflammation the tissue is dark in color, smooth, airless, at a somewhat lower level than the hepatized portion, and differs distinctly in color and appearance from the other portions of the lung. This is the condition to which the term *splenization* has been given. It really represents a tissue in the early stage of inflammation, and it perhaps would be as well to give up the use of this term and also that of *carnification*, which is only a more advanced stage.

There are three groups of cases: (1) Those in which the bronchitis and bronchiolitis are most marked, and in which there may be no definite consolidation, and yet on microscopic examination many of the alveolar passages and adjacent air-cells appear filled with inflammatory products. (2) The disseminated broncho-pneumonia, in which there are scattered areas of peribronchial hepatization with patches of collapse, while a considerable proportion of the lobe is still crepitant. This is by far the most common condition. (3) The pseudo-lobar form, in which the greater portion of the lobe is consolidated, but not uniformly, for intervening strands of dark congested lung tissue separate the groups of hepatized lobules.

Microscopically, the centre of the bronchus is seen filled with a plug of exudation, consisting of leucocytes and swollen epithelium. Section in the long axis may show irregular dilatations of the tube. The bronchial wall is swollen and infiltrated with cells. Under a low power it is readily seen that the air-cells next the bronchus are mostly densely filled, while toward the periphery the alveolar exudation becomes less. The contents of the air-cells are made up of leucocytes and swollen epithelial cells in varying proportions. Red corpuscles are not often present and a fibrin network is rarely seen, though it may be present in some alveoli. In the swollen walls are seen distended capillaries and numerous leucocytes. As Delafield has pointed out,

the interstitial inflammation of the bronchi and alveolar walls is the special feature of broncho-pneumonia.

The histological changes in the aspiration or deglutition broncho-pneumonia differ from the ordinary post-febrile form in a more intense infiltration of the air-cells with leucocytes, producing suppuration and foci of softening; even gangrene may be present.

Bacteriology.—The organisms most commonly found in broncho-pneumonia are *Micrococcus lanceolatus*, *Streptococcus pyogenes* (either alone or with the pneumococcus), *Staphylococcus aureus et albus*, Friedländer's *Bacillus pneumoniæ*, and the influenza bacillus. The Klebs-Loeffler bacillus is not infrequently found in the secondary lesions of diphtheria. Except the pneumococcus these microbes are rarely found in pure cultures. In the lobular type the streptococcus is the most constant organism, in the pseudo-lobar the pneumococcus. Mixed infections are almost the rule in broncho-pneumonia.

Terminations of Broncho-pneumonia.—(*a*) In *resolution*, which when it once begins goes on more rapidly than in fibrinous pneumonia. Broncho-pneumonia of the apices, in a child, persisting for three or more weeks, particularly if it follow measles or diphtheria, is often tuberculous. In these instances, when resolution is supposed to be delayed, caseation has in reality taken place. (*b*) In *suppuration*, which is rarely seen apart from the aspiration and deglutition forms, in which it is extremely common. (*c*) In *gangrene*, which occurs under the same conditions. (*d*) In *fibroid changes—chronic broncho-pneumonia*—a rare termination in the simple, a common sequence of the tuberculous, disease. Formerly it was thought that one of the most common changes in broncho-pneumonia, particularly in children, was caseation; but this is really a tuberculous process, the natural termination of an originally specific broncho-pneumonia. It is of course quite possible that a broncho-pneumonia, simple in its origin, may subsequently be the seat of infection by *Bacillus tuberculosis*.

Symptoms.—The *primary* form sets in abruptly with a chill or a convulsion. The child has not had a previous illness, but there may have been slight exposure. The temperature rises rapidly and is more constant; the physical signs are more local and there is not the widespread diffuse catarrh of the smaller tubes. Many cases are mistaken for lobar pneumonia. In others the pulmonary features are in the background or are overlooked in the intensity of the general or cerebral symptoms. The termination is often by crisis, and the recovery is prompt. The mortality of this form is slight. S. West has called attention to the importance of recognizing these primary cases and to their resemblance in clinical features to acute lobar pneumonia. The *secondary* form begins usually as a bronchitis of the smaller tubes. Much confusion has arisen from the description of capillary bronchitis as a separate affection, whereas it is only a part, though a primary and important one, of broncho-pneumonia. At the outset it may be said that if in convalescence from measles or whooping-cough a child has an accession of fever with cough, rapid pulse, and rapid breathing, and if, on auscultation, fine râles are heard at the bases, or widely spread throughout the lungs, even though neither consolidation nor blowing breathing can be detected, the diagnosis of broncho-pneumonia may safely be made. I have never seen in a fatal case after diphtheria or measles a capillary bronchitis as the sole lesion. The onset

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Group of Chemical and Physical Apparatus

is rarely sudden, or with a distinct chill; but after a day or so of indisposition the child becomes feverish and begins to cough and be short of breath. The fever is extremely variable; a range of from 102° to 104° F. is common. The skin is very dry and hot. The cough is hard, distressing, and may be painful. Dyspnœa gradually becomes a prominent feature. Expiration may be jerky and grunting. The respirations may rise as high as 60 or even 80 per minute. Within the first forty-eight hours the percussion resonance is not impaired; the note, indeed, may be very full at the anterior borders of the lungs. On auscultation, many râles are heard, chiefly the fine subcrepitant variety, with sibilant rhonchi. There may really be no signs indicating that the parenchyma of the lung is involved, and yet even at this early stage, within forty-eight hours of the onset of the pulmonary symptoms, I have repeatedly, after diphtheria, found scattered nodules of lobular hepatization. Northrup, in a case in which death occurred within the first twenty-four hours, in addition to the extensive involvement of the smaller bronchi, found the intralobular tissue also involved in places. The dyspnœa is constant and progressive and soon signs of deficient aëration of the blood are noted. The face becomes a little suffused and the finger-tips bluish. The child has an anxious expression and gradually enters upon the most distressing stage of asphyxia. At first the urgency of the symptoms is marked, but soon the influence of the toxins on the nerve-centres is seen and the child no longer makes strenuous efforts to breathe. The cough subsides, and, with a gradual increase in lividity and a drowsy restlessness, the right ventricle becomes more and more distended, the bronchial râles become more liquid as the tubes fill with mucus, and death follows. These are symptoms of a severe case of broncho-pneumonia, or what the older writers called *suffocative catarrh*.

The PHYSICAL SIGNS may at first be those of capillary bronchitis, as indicated by the absence of dulness and the presence of fine subcrepitant and whistling râles. In many cases death takes place before any definite pneumonic signs are detected. When these exist they are much more frequent at the bases, where there may be areas of impaired resonance or even of positive dulness. When numerous foci involve the greater part of a lobe the breathing may become tubular, but in the scattered patches of ordinary broncho-pneumonia, following the fevers, the breathing is more commonly harsh than blowing. In grave cases there is retraction of the base of the sternum and of the lower costal cartilages during inspiration, pointing to deficient lung expansion.

Diagnosis.—With lobar pneumonia it may readily be confounded if the areas of consolidation are large and merged together. It is to be remembered, as Holt's figures well show, that broncho-pneumonia occurs chiefly in children under one year, whereas lobar pneumonia is more common after the third year. No writer has so clearly brought out the difference between pneumonia at these periods as Gerhard,* of Philadelphia, whose papers on this subject have the freshness and accuracy which characterized all the writings of that eminent physician. Between lobar pneumonia and the secondary form of broncho-pneumonia the diagnosis is easy. The mode of onset is essentially different in the two infections, the one developing insidiously in the course or at the conclusion of another disease, the other setting in abruptly in a

* American Journal of Medical Sciences, vols. xiv and xv.

child in good health. In lobar pneumonia the disease is usually unilateral, in broncho-pneumonia bilateral. The chief trouble arises in cases of primary broncho-pneumonia, which by aggregation of the foci involves the greater part of one lobe. Here the difficulty is very great, and the physical signs may be practically identical, but in broncho-pneumonia it is much more likely that a lesion, however slight, will be found on the other side.

A still more difficult question to decide is whether an existing broncho-pneumonia is simple or tuberculous. In many instances the decision cannot be made, as the circumstances under which the disease occurs, the mode of onset, and the physical signs may be identical. It has often been my experience that a case has been sent down from the children's ward to the dead house with the diagnosis of post-febrile broncho-pneumonia in which there was no suspicion of the existence of tuberculosis; but on section there were found tuberculous bronchial glands and scattered areas of broncho-pneumonia, some of which were distinctly caseous, while others showed signs of softening. It is well to emphasize the fact that there are many cases of broncho-pneumonia in children which time alone enables us to distinguish from tuberculosis. The existence of extensive disease at the apices or central regions is a suggestive indication, and signs of softening may be detected. In the vomited matter, which is brought up after severe spells of coughing, sputum may be picked out and elastic tissue and tubercle bacilli detected.

It must not be forgotten that, as in lobar pneumonia, cerebral symptoms may mask the true nature of the disease, and may even lead to the diagnosis of meningitis. I recall more than one instance in which it could not be satisfactorily determined whether the infant had tuberculous meningitis or a cerebral complication of an acute pulmonary affection.

Prognosis.—In the primary form the outlook is good. In children enfeebled by constitutional disease and prolonged fevers broncho-pneumonia is terribly fatal, but in cases coming on in connection with whooping-cough or after measles recovery may take place in the most desperate cases. It is in this disease that the truth of the old maxim is shown—"Never despair of a sick child." The death rate in children under five has been variously estimated at from 30 to 50 per cent. After diphtheria and measles thin, wiry children seem to stand broncho-pneumonia much better than fat, flabby ones. In adults the aspiration or deglutition pneumonia is a very fatal disease.

Prophylaxis.—Much can be done to reduce the probability of attack after febrile affections. Thus, in the convalescence from measles and whooping-cough, it is very important that the child should not be exposed to cold, particularly at night, when the temperature of the room naturally falls. The use of light flannel "combinations" obviates this nocturnal chill, which is, I am sure, an important factor in the colds and pulmonary affections of young children. The catarrhal troubles of the nose and throat should be carefully attended to, and during fevers the mouth should be washed two or three times a day with an antiseptic solution.

Treatment.—The frequency and the seriousness of broncho-pneumonia render it a disease which taxes to the utmost the resources of the practitioner. There is no acute pulmonary affection over which he at times so greatly despairs. On the other hand, there is not one in which he will be more gratified in saving patients who have seemed past all succor. The general

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measures are much as in lobar pneumonia. The patient should be in the open air if possible; if indoors, the windows should be wide open with the patient protected from drafts.

(*a*) DIET.—As much food as possible should be given. Milk and its modifications, ice cream, eggs, broths, cocoa, and gruels are suitable. Water should be given freely by mouth and if this is not possible by the bowel or by infusion. ~~Alcohol is usually indicated and best given as whisky to adults and brandy to young children.~~ The *bowels* should be opened by castor oil or calomel and care taken to secure a daily movement.

(*b*) HYDROTHERAPY.—This may be given by various methods to be chosen for each patient, depending on the condition and results. Sponges may be given to any patient. Packs are useful, hot if there is much restlessness or cold if the temperature is high, or baths may be given to children for short periods, using water at 95° F. and gradually reducing to 75° or 80° F. Applying small amounts of cold water to the chest during the bath is sometimes useful, particularly if the respirations are shallow. Compresses, made out of linen covered by flannel or of flannel alone, wrung out of water at 60° to 70°, are particularly indicated and should be changed every one or two hours. They should not be covered by oiled silk. A mustard bath is of value for children, especially early in the attack. Alternate douches of hot and cold water are useful, particularly in children, when the condition is severe. Hydrotherapy is especially indicated for patients with high fever, delirium or stupor, severe toxæmia, or circulatory failure.

(*c*) LOCAL APPLICATIONS.—Poultices have gone out of fashion but are sometimes of value. They should be light and are best kept in place by being slipped in pockets in a flannel jacket which is constantly worn so that the poultice can be replaced without disturbing the patient. The use of dry cups is often advised; they should be applied frequently. The ice bag should be used if it gives comfort.

(*d*) MEDICINAL.—The indications must be carefully studied and drugs which may disturb the stomach given with care. If cough is distressing the use of the compound tincture of benzoin in an inhalation should be tried. The expectorant drugs may aid and of these ammonium chloride (gr. ii to v, 0.13 to 0.3 gm.) and the wine of ipecacuanha (♏ x to xx, 0.6 to 1.3 c.c.) are the most useful. To these a sedative, such as paregoric (3 i, 4 c.c.), codeia (gr. ¼, 0.016 gm.) or heroin (gr. 1-20, 0.0032 gm.) should be added if the cough is very distressing. Strychnine hypodermically (gr. 1-40 to 1-20, 0.0016 to 0.0032 gm.) is an aid to the respiratory centre and to the circulation. For circulatory failure the treatment is the same as described under lobar pneumonia. With increasing difficulty in getting up the secretions an emetic may be given, but only to robust patients. Ipecacuanha or apomorphine hypodermically should be employed. Inhalations of oxygen are advisable if they give relief to the dyspnœa and lessen cyanosis.

In old persons early stimulation is usually advisable and every effort should be made to persuade them to take nourishment. Cold applications or sponges must be used with caution and the use of heat is generally better. At all ages frequent change in position is advisable and in young children this may be done by taking them out of bed and holding them in the arms.

C. OTHER PNEUMOCOCCIC INFECTIONS

The organism is widely distributed and causes a number of important affections other than pulmonary, of which the following are the most important:

1. **Acute Septicæmia.**—A few instances have been reported in which without any recognized local lesion there has been a general infection with the pneumococcus. In Townsend's case, a girl, aged six, had pain in the abdomen, vomiting and a temperature of 104.2° F. without any throat affection. Death occurred in thirty hours, and a general infection with the organism was found in the blood, spleen, lungs and kidneys.

2. **Local Affections.**—The local affections caused by the pneumococcus are very numerous and will be described under their appropriate sections. In the *mouth,* erosions, gingivitis and glossitis; in the *pharynx,* inflammation and tonsillitis; in the *ear,* acute and chronic suppuration; in the accessory sinuses, of which it is a common habitat, inflammation and suppuration; in the *membrane of the brain* it is a common cause of primary and secondary meningitis; in the *bronchi* it has been found associated with acute and chronic bronchitis, and bronchiectasis; in the *lungs,* in addition to the two important diseases already considered, it may cause acute œdema and is associated with tuberculosis and many chronic affections. It has been found in acute pleurisy and it is one of the common causes of empyema; acute arthritis, primary and secondary forms; acute peritonitis, particularly in children; appendicitis; endocarditis; pyelitis and local abscesses in various parts may be caused by it.

VII. CEREBRO-SPINAL FEVER

Definition.—An infectious disease, occurring sporadically and in epidemics, caused by the *Diplococcus intracellularis,* characterized by inflammation of the cerebro-spinal meninges and a clinical course of great irregularity.

The affection is also known by the names of malignant purpuric fever, petechial fever, and spotted fever.

History.—Vieusseux first described a small outbreak in Geneva in 1805. In 1806 L. Danielson and E. Mann (Medical and Agricultural Register, Boston) gave an account of "a singular and very mortal disease which lately made its appearance in Medfield, Mass." The Massachusetts Medical Society, in 1809, appointed James Jackson, Thomas Welch, and J. C. Warren to investigate it. Elisha North's little book (1811) gives a full account of the early epidemics. Stillé's monograph (1867) and the elaborate section in vol. i of Joseph Jones' works contain details of the later American outbreaks. In his Geographical Pathology, Hirsch divides the outbreaks into four periods: From 1805 to 1830, in which the disease was most prevalent throughout the United States; a second period, from 1837 to 1850, when the disease prevailed extensively in France, and there were a few outbreaks in the United States; a third period, from 1854 to 1874, when there were outbreaks in Europe and several extensive epidemics in America. During the Civil War there were comparatively few cases. It prevailed extensively in the Ottawa Valley early in the seventies. In the fourth period, from 1875 to the present time, the disease has broken out in a great many regions. During the past

Epidemic cerebro-spinal meningitis.

1974 deaths. aged women (average of 5 prec. years
153)

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(3%) - (6) - (14%)

149 ?

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~~twenty~~ years there have been localized outbreaks in many lands. In the United States, during 1898-1899, it prevailed in mild form in 27 states. Since 1899 there have been extensive outbreaks in Silesia, and in the cities of the United States on the Atlantic coast. In New York in 1904-5 there were 6,755 cases and 3,455 deaths. In the British Isles there have been epidemics in Glasgow and Belfast, and a few scattered outbreaks. In Glasgow in 1907 there were nearly 1,000 cases with 595 deaths (Chalmers). In Belfast in the eighteen months ending June, 1908, there were 725 cases with 548 deaths (Robb). The wave of epidemic prevalence during the past three years, 1909-12, has been subsiding. There were only 130 deaths in England and Wales in 1909.

Etiology.—Cerebro-spinal fever occurs in epidemic and in sporadic forms. The *epidemics* are localized, occurring in certain regions, and are rarely very widespread. As a rule, country districts have been more afflicted than cities. Mining districts and seaports have suffered most severely. The outbreaks have occurred most frequently in the winter and spring. The concentration of individuals, as of troops in ~~large~~ barracks, seems to be a special factor, and epidemics on the Continent show how liable recruits and young soldiers are to the disease. In civil life children and young adults are most susceptible. Of Koplik's ~~78~~ cases 60 per cent. were under two years of age. Over-exertion, long marches in the heat, depressing mental and bodily surroundings, and the misery and squalor of the large tenement houses in cities are predisposing causes. The disease is not highly contagious, and is probably not transmitted by clothing or the excretions. It is very rare to have more than one or two cases in a house, and in a city epidemic the distribution of the cases is very irregular. Councilman found five instances in which the same individual is reported to have had the disease twice. Meningitis carriers, persons who have the germ in their throats or noses, but who are themselves unaffected, play an important rôle in transmitting the disease.

Sporadic cerebro-spinal fever occurs in all civilized countries. The disease lingers indefinitely after an outbreak, and in all large cities a moderate number of cases occur every year. The meningitis in children, known as the *simple* or *posterior basic,* is the sporadic form. It has two suggestive features of similarity in the seasonal incidence and in the fact that patients recover. Still determined the identity of the organism with the meningococcus, and the view has been confirmed by Koplik and many others.

Bacteriology.—In 1877 Weichselbaum described an organism, the *Diplococcus intracellularis meningitidis,* which was probably the same as one previously found by Leichtenstern. In the tissues the organism is almost constantly within the polynuclear leucocytes. In cultures it has well-characterized features, and is distinguishable from the pneumococcus. Since Weichselbaum's observations this organism has been met with in all carefully studied epidemics of the disease. The studies of Councilman in Boston and the numerous observers in the Glasgow, Belfast, New York, and Silesian epidemics have confirmed the constancy of this organism in the disease. Three important facts have been brought out—the presence of the germ in fully half the cases in the naso-pharynx, the existence of it in healthy contacts, and the preparation of a curative serum, to be referred to later.

Morbid Anatomy.—In malignant cases there may be no characteristic

changes, the brain and spinal cord showing only extreme congestion, which was the lesion described by Vieusseux. In a majority of the acutely fatal cases death occurs within the first week. There is intense injection of the pia-arachnoid. The exudate is usually fibrino-purulent, most marked at the base of the brain, where the meninges may be greatly thickened and plastered over with it. On the cortex there may be much lymph along the larger fissures and in the sulci; sometimes the entire cortex is covered with a thick, purulent exudate. It deserves to be recorded that Danielson and Mann made five autopsies and were the first to describe "a fluid resembling pus between the dura and pia mater." The cord is always involved with the brain. The exudate is more abundant on the posterior surface, and involves, as a rule, the dorsal and lumbar regions more than the cervical portion.

In the more chronic cases there is general thickening of the meninges and scattered yellow patches mark where the exudate has been. The ventricles in the acute cases are dilated and contain a turbid fluid, or in the posterior cornua pure pus. In the chronic cases the dilatation may be very great. The brain substance is usually a little softer than normal and has a pinkish tinge; foci of hæmorrhage and of encephalitis may be found. The cranial nerves are usually involved, particularly the second, fifth, seventh, and eighth. The spinal nerve roots are also found imbedded in the exudate.

Microscopically, the exudate consists largely of polynuclear leucocytes closely packed in a fibrinous material. In some instances there are foci of purulent infiltration and hæmorrhage. The neuroglia cells are swollen, with large, clear, and vesicular nuclei. The ganglion cells show less marked changes. Diplococci are found in variable numbers in the exudate, being more numerous in the brain than in the cord.

In one of the Boston cases, examination of the nasal secretion during life showed diplococci, and in this instance there was found post mortem a purulent infiltration of the mucous membrane. In two other cases this membrane was normal.

Pneumonia and pleurisy have been described in the disease. Councilman reports that in 13 cases there was congestion with œdema, in 7 broncho-pneumonia, in 2 characteristic croupous pneumonia with pneumococci; in 8 pneumonia due to the diplococcus intracellularis was present.

The *spleen* varies a good deal in size. In only three of the Boston fatal cases was it found much enlarged. The *liver* is rarely abnormal. Acute *nephritis* is sometimes present. The intestines show sometimes swelling of the follicles.

Symptoms.—Cases differ remarkably in their characters. Many different forms have been described. These are perhaps best grouped into three classes:

(*a*) Malignant Form.—This fulminant or apoplectic type is found with variable frequency in epidemics. It may occur sporadically. The onset is sudden, usually with violent chills, headache, somnolence, spasms in the muscles, great depression, moderate elevation of temperature, and feeble pulse, which may fall to fifty or sixty in the minute. Usually a purpuric rash develops. In a Philadelphia case, in 1888, a young girl, apparently quite well, died within twenty hours of this form. There are cases on record in which death has occurred within a shorter time. Stillé tells of a child of five years, in whom death occurred after an illness of ten hours; and refers to a case

reported by Gordon, in which the entire duration of the illness was only five hours. Two of Vieusseux's cases died within twenty-four hours.

(*b*) Ordinary Form.—The stage of incubation is not known. The disease usually sets in suddenly. There may be premonitory symptoms: headache, pains in the back, and loss of appetite. More commonly, the onset is with headache, severe chill, and vomiting. The temperature rises to 101° or 102°. The pulse is full and strong. An early and important symptom is a painful stiffness of the muscles of the neck. The headache increases, and there are photophobia and great sensitiveness to noises. Children become very irritable and restless. In severe cases the contraction of the muscles of the neck sets in early, the head is drawn back, and when the muscles of the back are also involved, there is orthotonos, which is more common than opisthotonos. The pains in the back and in the limbs may be very severe. The motor symptoms are most characteristic. Tremor of the muscles may be present, with tonic or clonic spasms in the arms or legs. Rigidity of the muscles of the back or neck is very common, and the patient lies with the body stiff and the head drawn so far back that the occiput may be between the shoulder-blades. Except in early childhood convulsions are not common. Strabismus is a frequent and important symptom. Spasm of the muscles of the face may also occur. Cases have been described in which the general rigidity and stiffness was such that the body could be moved like a statue. Paralysis of the trunk muscles is rare, but paralysis of the muscles of the eye and the face is not uncommon.

Of sensory symptoms, headache is the most dominant and persists from the outset. It is chiefly in the back of the head, and the pain extends into the neck and back. There may be great sensitiveness along the spine, and in many cases there is general hyperæsthesia.

The psychical symptoms are pronounced. Delirium occurs at the onset, occasionally of a furious and maniacal kind. The patient may display marked erotic symptoms at the onset. The delirium gives place in a few days to stupor, which, as the effusion increases, deepens to coma.

The temperature is irregular and variable. Remissions occur frequently, and there is no uniform or typical curve during the disease. In some instances there has been little or no fever. In others the temperature may reach 105° or 106° F., or, before death, 108° F. The pulse may be very rapid in children; in adults it is at first usually full and strong. In some cases it is remarkably slow, and may not be more than fifty or sixty in the minute. Sighing respirations and Cheyne-Stokes breathing are met with in some instances. Unless there is pneumonia the respirations are not often increased in frequency.

The cutaneous symptoms ~~of the disease~~ are important. Herpes occurs with a frequency almost equal to that in pneumonia or intermittent fever. The petechial rash, which has given the name spotted fever to the disease, is very variable. Stillé states that of 98 cases in the Philadelphia Hospital, no eruption was observed in 37. In the Montreal cases petechiæ and purple spots were common. They appear to have been more frequent in the epidemics in America than in Europe. The petechiæ may be numerous and cover the entire skin. An erythema or dusky mottling may be present. In some instances there have been rose-colored hyperæmic spots like the typhoid rash.

Urticara or erythema nodosum, ecthyma, pemphigus, and in rare instances gangrene of the skin have been noted.

Leucocytosis is an early and constant feature, and ranges from 25,000 to 40,000 per cubic millimetre. It persists even in the most protracted cases. The diplococcus intracellularis has been isolated from the blood during life and demonstrated in the leucocytes.

As already stated, vomiting may be a special feature at the onset; but, as a rule, it gradually subsides. In some instances, however, it persists and becomes the most serious and distressing of the symptoms. Diarrhœa is not common, the bowels being usually constipated. The abdomen is not tender. In the acute form the spleen is usually enlarged.

The urine is sometimes albuminous and the quantity may be increased. Glycosuria has been noted in some instances, and in the malignant types hæmaturia.

The duration of the disease is extremely variable. Hirsch rightly states that it may range between a few hours and several months. More than half of the deaths occur within the first five days. In favorable cases, after the symptoms have persisted for five or six days, improvement is indicated by a lessening of the spasm, reduction of the fever, and a return of the intelligence. A sudden fall in the temperature is of bad omen. Convalescence is extremely tedious, and may be interrupted by complications and sequelæ, ~~to be noted~~.

(*c*) Anomalous Forms.—(1) *Abortive Type.*—The attack sets in with great severity, but in a day or two the symptoms subside and convalescence is rapid. Strümpell would distinguish between this abortive variety, which begins with such intensity, and the mild ambulant cases described by certain writers. He reports a case in which the meningeal symptoms set in with the greatest intensity and persisted for four days, the temperature rising to 105.6° F. On the fifth day the patient entered upon a rapid ~~and satisfactory~~ convalescence. In the mild cases, as distinguished from the abortive, the patients complain of headache, nausea, sensations of discomfort in the back and limbs, and stiffness in the neck. There is little or no fever, and only moderate vomiting. These cases could be recognized only during the prevalence of an epidemic.

(2) *An intermittent* type has been observed in many epidemics, and ~~is~~ was recognized by von Ziemssen and Stillé. It is characterized by exacerbations of fever, which may recur daily or every second day, or follow a curve of an intermittent or remittent character. The pyrexia resembles that of pyæmia rather than malaria.

(3) *Chronic Form.*—Heubner states that this is a relatively frequent form, though it does not seem to be recognized by many writers on the subject. An attack may be protracted for from two to five or even six months, and may cause the most intense marasmus. It is characterized by a series of recurrences of the fever, and may present the most complex symptomatology. It is not improbable that in these protracted cases chronic hydrocephalus or abscess of the brain is present. This form differs distinctly from the intermittent type. Three cases in our series were of this chronic form; in one the disease persisted for ninety days.

Complications.—Pleurisy, pericarditis, and parotitis are not uncommon.

superior frontal
Percussion over the right parietal bone gives dull
tympanitic note (Macewan's sign). The child shows
head in the upright position with the head inclined to
one side.

Pneumonia is described as frequent in certain outbreaks. Immermann found, during the Erlangen epidemic, many instances of the combination of pneumonia with meningitis, but it does not seem possible to determine whether, in such cases, pneumonia is the primary disease and the meningitis secondary, or *vice versa*. The frequency with which inflammation of the meninges of the brain complicates pneumonia is well known. Councilman suggests that the pneumonia of the disease is not the true ~~croupous~~ form, but due to the diplococcus meningitidis. This was found in eight of the Boston cases, and in one it was so extensive that it could have been mistaken for the ordinary ~~croupous~~ pneumonia. Cerebro-spinal fever sometimes prevails extensively with ordinary pneumonia, as in New York in the winter of 1903-'04. *Arthritis* has been the most frequent complication in certain epidemics. Many joints are affected simultaneously, and there are swelling, pain, and exudation, sometimes serous, sometimes purulent. This was first observed by James Jackson, Sr., in the epidemic which he described. Enteritis is rare.

Headache may persist for months or years after an attack. Chronic hydrocephalus occurs in certain instances in children. The symptoms of this are "paroxysms of severe headache, pains in the neck and extremities, vomiting, loss of consciousness, convulsions, and involuntary discharges of fæces and urine" (von Ziemssen). Mental feebleness and aphasia have occasionally been noted.

Paralysis of individual cranial nerves or of the lower extremities may persist for some time. In some of these cases there may be peripheral neuritis, as Mills suggested.

Special Senses.—*Eye.*—Optic neuritis may follow involvement of the nerve in the exudation at the base. Acute papillitis was found in 6 out of 40 cases examined by Randolph. The inflammation may extend directly into the eye along the pia-arachnoid of the optic nerve, causing purulent choroido-iritis or even keratitis. A neuritis of the fifth nerve may be followed by keratitis and purulent conjunctivitis.

Ear.—Deafness very often follows inflammation of the labyrinth. Otitis media, with mastoiditis, may occur from direct extension. In 64 cases of meningitis which recovered, Moos found that 55 per cent. were deaf. He suggests that the abortive form of the disease may be responsible for many cases of early acquired deafness. In children this not infrequently leads to deaf-mutism. Von Ziemssen states that in the deaf and dumb institutions of Bamberg and Nuremberg, in 1871, a majority of the pupils had become deaf from epidemic cerebro-spinal meningitis.

Nose.—Coryza is not infrequent early in the disease, and Strümpell says that in many of his cases nasal catarrh preceded the meningitis. He suggests that the latter may be caused by infection from the nose. Certainly the nasal secretion appears frequently to contain the diplococci—in 18 cases examined by Scherrer, and in 10 out of 15 of the Boston cases.

Diagnosis.—Much has been done of late to enable the practitioner to recognize definitely the existence of meningitis and of the various forms.

(*a*) General Features.—The fever, headache, delirium, retraction of the neck, tremor, and rigidity of the muscles are most important signs. As already mentioned, in the meningitis of cerebro-spinal fever the spinal symptoms are very much more marked than in the other forms. One has constantly to

bear in mind that certain cases of typhoid fever and of pneumonia closely simulate cerebro-spinal meningitis. Long ago Stokes made the wise observation that "there is no single nervous symptom which may not and does not occur independently of any appreciable lesion of the brain, nerves, or spinal cord."

(*b*) Among the SPECIAL DIAGNOSTIC FEATURES may be mentioned:

Kernig's Sign.—When the thigh is flexed at right angles to the abdomen, the leg can be extended upon the thigh nearly in a straight line. If meningitis be present, strong contractures of the flexors prevent the full extension of the leg on the thigh.

Brudzenski's Sign.—Flexing the head on the chest causes flexion of the legs at the hip and knee joints, and flexing one leg on the trunk produces the same movement in the other leg.

Lumbar Puncture.—The procedure is quite harmless, and in a majority of the cases can be done without general anæsthesia, with the aid of a local freezing mixture. As a rule, it is best in children to give a whiff or two of chloroform. The patient is turned on the side with the back bowed and the knees drawn up. As a rule, there is no difficulty in finding the spinal processes, and with the thumb or index finger of the left hand as a guide, a small aspirator needle is inserted slightly to one side of the median line and thrust deeply into the third lumbar interspace in an upward and inward direction. At a variable distance, according to the age and musculature, the needle enters the spinal canal—about two and a half centimetres in infants and from four to six centimetres in adults. The fluid runs, as a rule, drop by drop, and when meningitis is present it is usually turbid, sometimes purulent, occasionally bloody. Meningitis may be present with a clear fluid. The pressure under which the fluid flows may reach 250-300 mm., the normal being about 120 mm. Cover-glass preparations should be made and studied, and the character of the organisms carefully noted. The cover-slip preparations may give the diagnosis at once. In acute cases of cerebro-spinal fever the organisms may be present in large numbers. There is rarely any difficulty in determining between the pneumococcus and the ~~diplococcus intracellularis~~. Should the fluid be sterile and tuberculosis suspected, a guinea-pig may be inoculated.

Prognosis.—Hirsch states that the mortality has ranged in various epidemics from 20 to 75 per cent. In children the death rate is much higher than in adults. The earlier ~~in the course~~ the serum is given the better the outlook.

Prophylaxis.—The patient should be isolated and the secretions from the nose, the sputum and urine disinfected. A carbolic mouth wash and an antiseptic spray for the nose should be used. The attendants should adopt measures to keep the nose and mouth clean.

Treatment.—The patient should be kept as quiet as possible, handled gently, and all causes of irritation removed. Special attention should be given to the care of the skin owing to the danger of bedsores. The hair should be clipped close and an ice bag applied to the head. The diet should be liquid, as concentrated as possible, and given at short intervals. If swallowing is difficult the patient can be fed through a tube. Water should be given freely. The bowels are to be opened by a calomel and saline purge, and laxatives or enemata used later if necessary. For severe headache, general pains or vomit-

anil x. ell

meningococcus Lanfol seared microscopically shows T.B. of tuberculous case

if restless. Tr. gr xx. - xxx. ad ℥ ij

Lewis - Gunda v Flack - B.M.J. Nov. 18. 16

1). direct application of 1% soln. chloramine
2) inhalation of steam spray charged with 2% sulphur

ing, morphia hypodermically is usually best. The administration of hexamethylenamine, sixty grains (4 gm.) a day is worthy of a trial.

Serum Therapy.—To Flexner we owe the specific serum which has reversed the mortality and recovery rates—one of the most striking advances in modern therapy. It should be given as early as possible in the course and also in doubtful cases. Whenever the fluid obtained by lumbar puncture is purulent the serum should be given, but repeated only if the meningococcus is found. Before giving the serum as much cerebro-spinal fluid as possible should be withdrawn. If this has been large in amount (over 40 c. c.) and in severe cases, 45 c. c. of the serum should be introduced through the needle. In ordinary cases 30 c. c. of the serum should be given. In all cases with abnormal resistance to the injection of serum after an amount equal to the fluid removed has been injected, it is well to stop. If the symptoms are very severe or increasing, the injection should be repeated in twelve hours. Otherwise the usual dose (30 c. c.) should be given daily for four days. If diplococci are found after this, daily injections should be continued. Continuance or exacerbation of the symptoms demands further injections. If the condition remains stationary after four days' interval, the four daily injections should be given again and this repeated until the diplococci disappear and the symptoms abate. In the chronic forms the serum should be given if diplococci are present and in the posterior basic form in the hope of benefit.

Hydrotherapy.—This may give relief to the symptoms. Hot baths are best at a temperature of 100° given for fifteen minutes every three hours. Hot packs may be used instead.

Lumbar Puncture.—Done for injection of the serum it is often of value in itself. Severe headache and marked cerebral features are indications. As much fluid as possible should be removed and if it escapes under high pressure early repetition is advisable. It should be done early and frequently with signs of accumulation of fluid in the ventricles.

Complications.—Conditions due to extension to the cranial nerves are not influenced by treatment. *Otitis* requires early incision and *arthritis* rest, local applications and incision if suppuration occurs. With signs of dilatation of the ventricles, drainage of the ventricle and injection of serum should be considered. In proper hands there is little risk. In the chronic cases every effort should be made to nourish the patient well and especial precautions taken against bed-sores. For the pain and stiffness sometimes occurring in convalescence, hot baths and massage are useful.

VIII. INFLUENZA

(*La Grippe*)

Definition.—A pandemic disease, appearing at irregular intervals, characterized by extraordinary rapidity of extension and the large number of people attacked. Following the pandemic there are, as a rule, for several years endemic, epidemic, or sporadic outbreaks in different regions. Clinically, the disease has protean aspects, but a special tendency to attack the respiratory mucous membranes. A special organism, *Bacillus influenzæ,* is found.

History.—Great pandemics have been recognized since the sixteenth century. There were four with their succeeding epidemics during the last century—1830-'33, 1836-'37, 1847-'48, and 1889-'90. The last pandemic seems to have begun, as many others had before, in the far East. It may have started in May, 1889, in Buchara, reaching Moscow in September, the Caucasus and St. Petersburg in October. By the middle of November Berlin was attacked. By the middle of December it was in London, and by the end of the month it had invaded New York, and was widely distributed over the entire continent. Within a year it had visited nearly all parts of the earth.

The duration of an epidemic in any one locality is from six to eight weeks. With the exception, perhaps, of dengue, there is no disease which attacks indiscriminately so large a portion of the inhabitants, about 40 per cent., as a rule. Fortunately, as in dengue, the rate of mortality is very low. Of 55,263 cases reported in the German army, 60 died, or about 0.1 per cent. As might be expected, in the civil population the mortality is somewhat higher, reaching 133, or about 0.5 per cent. of the 22,972 cases reported in Munich. Over one-half of these deaths were due to pneumonia. In 1909 the deaths in England and Wales numbered 8,992. The opportunity for studying the disease in the last epidemic has thrown much light upon many problems. Among the most notable productions were the work of Pfeiffer on the etiology, ~~of the disease~~, the elaborate Berlin report by von Leyden and Senator, and the Local Government Board's report by Parsons. Leichtenstern's article in Nothnagel's Handbuch is ~~the~~ most masterly and systematic consideration of the disease, ~~in the literature~~.

Etiology.—What relation has the epidemic influenza to the ordinary influenza cold or catarrhal fever (commonly also called the *grippe*), which is constantly present in the community? Leichtenstern answers this question by making the following divisions: (*a*) Epidemic *influenza vera,* caused by Pfeiffer's bacillus; (*b*) endemic-epidemic *influenza vera,* which often occurs for several years in succession after a pandemic, also caused by the same bacillus; (*c*) endemic *influenza nostras,* pseudo-influenza or catarrhal fever, commonly called the *grippe,* which is a special disease, still of unknown etiology, and which bears the same relation to the true influenza as cholera nostras does to Asiatic cholera.

Since the last pandemic we have not been free from local outbreaks in some part of the world. In some places the disease seems to have been continually present.

Ruhemann reports 1,979 cases of typical grippe between 1895 and 1902. In 115 he demonstrated the influenza bacillus. Lord (in Boston) demonstrated influenza bacilli in about 30 per cent. of 100 unselected cases of acute and chronic bronchitis. Yet during this period there was no epidemic of influenza in the city. The reports are sufficiently numerous to show that the influenza bacillus is probably constantly with us. Many observations show that it is a frequent invader of the respiratory tract in the inter-epidemic periods and is probably responsible for many of the cases of Leichtenstern's influenza nostras. Indeed, it seems to bear a similar relation to the acute infections of the respiratory tract as other common organisms. It is still unexplained why it should stand in a different relation to the epidemics of influenza as the sole cause of the disease.

✓ 1915 - 10484 deaths. largest rate for many years
10484

probably caused by various organisms (especially
pneumococci and Staphylococci)

~~organism in blood~~

Influenza b. is responsible for many cases
of acute bronchitis

Pathology

Tonsilitis, laryngitis, bronchitis.

bronchi?
lobar?

abscess organisms
pulmonary tb.
chronic infections

The disease is highly contagious; it spreads with remarkable rapidity, which, however, is not greater than modern methods of conveyance. In the great pandemic of 1889-'90 some of the large prisons escaped entirely. The outbreak of epidemics is independent of all seasonal and meteorological conditions, except perhaps sunshine. The worst have been in the colder seasons of the year. One attack does not necessarily protect from a subsequent one. A few persons appear not to be liable to the disease.

Bacteriology.—In 1892 Pfeiffer isolated a bacillus from the nasal and bronchial secretions, which is recognized as the cause of the disease. It is a small, non-motile organism, which stains well in Loeffler's methylene blue, or in a dilute, pale-red solution of carbol-fuchsin in water. The bacilli are present in enormous numbers in the nasal and bronchial secretions of patients, in the latter almost in pure cultures. They persist often after the severe symptoms have subsided.

The much-discussed question whether during the presence of an epidemic human influenza attacks animals must be answered in the negative. In great pandemics of influenza the general rule seems to hold that other diseases do not prevail to the same extent, but it may be that other diseases are wrongly included under influenza.

Symptoms.—The incubation period is "from one to four days; oftenest three to four days." The onset is usually abrupt, with fever and its associated phenomena.

Types of the Disease.—The manifestations are so extraordinarily complex that it is best to describe them under types of the disease.

(*a*) Respiratory.—The mucous membrane of the respiratory tract from the nose to the air-cells of the lungs may be regarded as the seat of election of the influenza bacilli. In the simple forms the disease sets in with coryza, and presents the features of an acute catarrhal fever, with perhaps rather more prostration and debility than is usual. In other cases after catarrhal symptoms bronchitis occurs, the fever increases, there is delirium and much prostration, and the picture may even be that of severe typhoid fever. The graver respiratory conditions are bronchitis, pleurisy, and pneumonia. The bronchitis has really no special peculiarities. The sputum is supposed by many to be distinctive. Sometimes it is in extraordinary amounts, very thin, and containing purulent masses. Pfeiffer regards sputum of a greenish-yellow color and in coin-like lumps as almost characteristic of influenza. In other cases there may be a dark red, bloody sputum. It occasionally happens that the bronchitis is of great intensity and reaches the finer tubes, so that the patient becomes cyanosed or even asphyxiated.

Influenza pneumonia is one of the most serious manifestations, and may depend upon Pfeiffer's bacillus itself, or is the result of a mixed infection. The true influenza pneumonia is most commonly ~~lobular or catarrhal~~ probably never ~~croupous~~. Much of the mortality of the disease depends upon the fatal character of this complication. The clinical course ~~of the cases~~ is often irregular and the symptoms ~~are~~ obscure or masked.

Influenza pleurisy is ~~more~~ rare, but cases of primary involvement of the pleura are reported. It is very apt to lead to empyema. Pulmonary tuberculosis is usually ~~much~~ aggravated by an attack of influenza.

(*b*) Nervous Form.—Without any catarrhal symptoms there are severe

headache, pain in the back and joints, with profound prostration. Among the more serious complications may be mentioned meningitis and encephalitis, the latter leading to hemiplegia or monoplegia. Abscess of the brain has followed in acute cases. Myelitis, with symptoms like an acute Landry's paralysis, has occurred, and spastic paraplegia or a pseudo-tabes may follow an attack.

The influenza bacillus has been demonstrated by lumbar puncture during life and in the meninges after death. All forms of neuritis are not uncommon, and in some cases are characterized by marked disturbance of motion and sensation. Judging from the accounts in the literature, almost every form of disease of the nervous system may follow influenza.

Among the most important of the nervous sequelæ are depression of spirits, melancholia, and in some cases dementia.

(*c*) Gastro-intestinal Form.—With the onset of the fever there may be nausea and vomiting, or the attack may set in with abdominal pain, profuse diarrhœa, and collapse. In some epidemics jaundice has been a common symptom. In a considerable number of the cases there is enlargement of the spleen, depending chiefly upon the intensity of the fever. This ~~was~~ a ~~very~~ rare form in the United States.

(*d*) Febrile Form.—The fever in influenza is very variable, but it is important to recognize that it may be the only manifestation of the disease. It is sometimes markedly remittent, with chills; or in rare cases there is a protracted, continued fever of several weeks' duration, which simulates typhoid closely. Sometimes the fever resembles that of a tertian malaria.

Complications.—The *pericarditis* is apt to be latent. Of *endocarditis*, a number of cases have been reported in which micro-organisms morphologically like influenza bacilli have been isolated from the vegetations. The malignant form may occur. Myocarditis may follow, and has been a cause of sudden death. Functional disturbances are common, palpitation, bradycardia, tachycardia, and angina-like attacks. Phlebitis and thrombosis of various vessels have been described.

Septicæmia was demonstrated by Meunier in four of eight cases by the cultivation of influenza bacilli from the circulating blood.

Peritonitis is rare. *Cholelithiasis* may follow an attack. The increased prevalence of *appendicitis* has been attributed to influenza.

Various renal affections have been noted. G. Baumgarten has called attention to the frequency of nephritis. Orchitis has been also seen. Herpes is common. A diffuse erythema sometimes occurs, occasionally purpura. Catarrhal conjunctivitis is a frequent event. Iritis, and in rare instances optic neuritis, have been met with. Acute otitis media is a common complication. I have seen severe and persistent vertigo follow influenza, probably from involvement of the labyrinth. Bronchiectasis may follow. I have seen several cases; in a fatal one of three years' duration the influenza bacilli were present in the sputum.

Since the late severe epidemics it has been the fashion to date various ailments or chronic ill health from influenza. In many cases this is correct. It is astonishing the number of people who have been crippled in health for years after an attack.

Diagnosis.—During a pandemic the cases offer but slight difficulty. The profoundness of the prostration, out of all proportion to the intensity of the

has been

found in a no. of cases in blood.

Pulmonary infections may be regarded as tuberc:

Tuberc. patients generally consti

(spit)

watch for exacerbations.

Dr. H. Gregson

disease, is one of the most characteristic features. In the respiratory form the diagnosis may be made by the bacteriological examination of the sputum, a procedure which should be resorted to early in a suspected epidemic. The differentiation of the various forms has been already sufficiently considered.

Treatment.—Isolation should be practised when possible, and old people should be guarded against all possible sources of infection. The secretions, nasal and bronchial, should be thoroughly disinfected. In every case the disease should be regarded as serious, and the patient should be confined to bed until the fever has completely disappeared. In this way alone can serious complications be avoided. From the outset the treatment should be supporting, and the patient should be carefully fed and well nursed. The bowels should be opened by a dose of calomel or a saline draught. At night 10 grains of Dover's powder may be given. At the onset a warm bath is sometimes grateful in relieving the pain in the back and limbs, but great care should be taken to have the bed well warmed, and the patient should be given after it a drink of hot lemonade. If the fever is high and there is delirium, small doses of antipyrin or aspirin (gr. x, 0.6 gm.) may be given and an ice-cap applied to the head. The medicinal antiypyretics should be used with caution, as profound prostration sometimes occurs after their employment. Too much stress should not be laid upon the mental features. Delirium may be marked even with slight fever. In the cases with great cardiac weakness stimulants should be given freely, and during convalescence strychnia in full doses.

The intense bronchitis, pneumonia, and other complications should receive their appropriate treatment. The convalescence requires careful management, and it may be weeks or months before the patient is restored to full health. A good nutritious diet, change of air, and pleasant surroundings are essential. The depression of spirits following this disease is one of its most unpleasant and obstinate features.

IX. WHOOPING COUGH

Definition.—A specific affection due ~~in all probability~~ to the Bordet bacillus, characterized by catarrh of the respiratory passages and a series of convulsive coughs which end in a long-drawn inspiration or "whoop."

History.—Ballonius, in his *Ephemerides,* describes the disease as it appeared in 1578. Glisson and Sydenham in the following century gave brief accounts. Willis (Pharmaceutice Rationalis, second part, 1674) gave a much better description and called it an "epidemical disorder."

Etiology.—The disease occurs in epidemic form, but sporadic cases appear in a community from time to time. It is directly contagious from person to person; but dwelling-rooms, houses, school-rooms, and other localities may be infected by a sick child. It is, however, in this way less contagious than other diseases, and is probably most often taken by direct contact. Epidemics prevail for two or three months, usually during the winter and spring, and have a curious relation to other diseases, often preceding or following epidemics of measles, less frequently of scarlet fever.

Children between the first and second dentitions are most liable to be attacked. Sucklings are, however, not exempt, and I have seen very severe

attacks in infants under six weeks. Congenital cases are described. It is stated that girls are more subject to the disease than boys. Adults and old people are sometimes attacked, and in the aged it may be a very serious affection. It appears to be most contagious in the catarrhal period. A natural immunity has been mentioned, but it must be remembered that a child may have the disease in a very mild form. As a rule, one attack protects; second attacks are excessively rare. Delicate anæmic children with nasal or bronchial catarrh are more subject to the disease than others. According to the United States Census Reports, the disease is more than twice as fatal in the negro race than in others. There were 7,182 deaths from it in 1909 in England and Wales.

An organism has been described by Bordet and Gengou, *Bacillus pertussis,* resembling in certain features the influenza bacillus. In convalescents the deviation of complement reaction is present and the serum is stated to agglutinate the organism.

Morbid Anatomy.—Whooping cough itself has no special pathological changes. In fatal cases pulmonary complications, particularly broncho-pneumonia, are usually present. Collapse and compensatory emphysema, vesicular and interstitial, are found, and the tracheal and bronchial glands are enlarged.

Symptoms.—There is a variable period of incubation of from seven to ten days. Catarrhal and paroxysmal stages can be recognized. In the *catarrhal stage* the child has the symptoms of an ordinary cold, which may begin with slight fever, running at the nose, injection of the eyes, and a bronchial cough, usually dry, and sometimes giving indications of a spasmodic character. Trousseau calls attention to the *incessant* character of the early cough. The fever is usually not high, and slight attention is paid to the symptoms, which are thought to be those of a simple catarrh. After ~~lasting for~~ a week or ten days, instead of subsiding, the cough becomes worse and more convulsive in character.

The *paroxysmal stage,* marked by the characteristic cough, dates from the first appearance of the "whoop." The fit begins with a series of from fifteen to twenty forcible short coughs of increasing intensity, between which no inspiratory effort is made. The child gets blue in the face, and then with a deep inspiration the air is drawn into the lungs, making the "whoop," which may be heard at a distance, and from which the disease takes its name. A deep inspiration may precede the series of spasmodic expiratory efforts. Several coughing fits may succeed each other until a tenacious mucus is ejected, usually small in amount, but after a series of coughing spells a considerable quantity may be expectorated. Vomiting often takes place at the end of a paroxysm, and may recur so frequently in the day that the child does not get enough food and becomes emaciated. There may be only four or five attacks in the day, or in severe cases they may recur every half-hour. In severe and fatal cases the paroxysms may exceed one hundred daily. During the paroxysm the thorax is very strongly compressed by the powerful expiratory efforts, and, as very little air passes in through the glottis, there are signs of defective aëration of the blood; the face becomes swollen and congested, the veins are prominent, the eyeballs protrude, and the conjunctivæ become deeply engorged. Suffocation indeed seems imminent, when with a deep, crowing inspiration air enters the lungs and the color is quickly restored. The child

Average gain in new territory in ...

Blitz deaths ...

Average 20 attacks

Sugar is occurring daily here.

knows for a few moments when the attack is coming on, and tries in every way to check it, but failing to do so, runs terrified to the nurse or mother to be supported, or clutches anything near by. Few diseases are more painful to witness. In severe paroxysms the sphincters may be opened. The urine is said to be of high specific gravity (1022-1032), pale yellow, and to contain much uric acid.

An ulcer may form under the tongue from rubbing on the teeth (Riga's disease).

During the attack, if the chest be examined, the resonance is defective in the expiratory stage, full and clear during the deep, crowing inspiration; but on auscultation during the latter there may be no vesicular murmur heard, owing to the slowness with which the air passes the narrowed glottis. Bronchial râles are occasionally heard.

Among circumstances which precipitate a paroxysm are emotion, such as crying, and any irritation about the throat. Even the act of swallowing sometimes seems sufficient. In a close dusty atmosphere the coughing fits are more frequent. After lasting for three or four weeks the attacks become lighter and finally cease. In cases of ordinary severity the course of the disease is rarely under six weeks.

Complications and Sequelæ.—~~The complications and sequelæ of whooping cough are important.~~ During the extensive venous congestion, hæmorrhages are very apt to occur in the form of petechiæ, particularly about the forehead, ecchymosis of the conjunctivæ, and even bleeding tears of blood (Trousseau) from the rupture of the vessels, epistaxis, bleeding from the ears, and occasionally hæmoptysis. Hæmorrhage from the bowels is rare. Convulsions are not very uncommon, due perhaps to the extreme engorgement of the cerebral cortex. Death has occurred from spasm of the glottis. Sudden death has been caused by extensive subdural hæmorrhage. Paralysis is a rare event. It was associated with 3 of my series of 120 cases, but in none of them did the hemiplegia come on during the paroxysm, as in a case reported by S. West. Valentine (1901) has collected 79 cases, chiefly hemiplegias. A spastic paraplegia may follow. Acute polyneuritis is a rare sequel.

The persistent vomiting may induce marked anæmia and wasting. The pulmonary complications are extremely serious. During the severe coughing spells interstitial emphysema may be induced, more rarely pneumothorax. I saw one instance in which rupture occurred, evidently near the root of the lung, and the air passed along the trachea and reached the subcutaneous tissues of the neck, a condition which has been known to become general. Capillary bronchitis, lobular and pseudo-lobar pneumonia are the dangerous complications, responsible for nine out of ten deaths in the disease. In some cases the process is tuberculous. Pleurisy is sometimes met with and occasionally lobar pneumonia. Enlargement of the bronchial glands is very common in whooping cough, and has been thought to cause the disease. It may sometimes be sufficient to produce dulness over the manubrium. During the spasm the radial pulse is small, the right heart engorged, and during and after the attack the cardiac action is very much disturbed. Serious damage may result, and possibly some of the cases of severe valvular disease in children who have had neither rheumatic nor scarlet fever may be attributed to the terrible heart strain during a prolonged attack. Koplik regards the

swelling about the face and eyes as an important sign of the heart strain. Serious renal complications are very uncommon, but albumin sometimes and sugar frequently are found in the urine. A distressing sequel in adults is asthma, which may recur at intervals for a year or more. An unusually marked leucocytosis appears early, chiefly of the lymphocytes (Meunier).

Diagnosis.—So distinctive is the "whoop" ~~of the disease~~ that the diagnosis is very easy; but occasionally there are doubtful cases, particularly during epidemics, in which a series of expiratory coughs occurs without any inspiratory crow.

Prognosis.—If we include its complications, whooping cough is a very fatal affection, ranking one of the first among the acute infections as a cause of death in children under five years of age. It exceeds diphtheria and scarlet fever in gross mortality.

Prophylaxis.—The disease should be placed on the list of reportable infections. When possible the sputum should be collected and disinfected. ~~As it~~ is highly probable that the contagion persists for a very long time, special care should be taken in the inspection of school children during their convalescence.

Treatment.—The gravity of the disease is scarcely appreciated by the public. Children with the disease should not be sent to school or exposed in public in any way. There is more reprehensible neglect in connection with this than with any other disease. The patient should be isolated, and if the paroxysms are at all severe, at rest in bed. Fresh air, night and day, is important, but in cities in the winter this is not easy to manage. The treatment is notoriously unsatisfactory. If asked the two most important things, I should say six weeks and a good big bottle of paregoric. Antiseptic measures have been extensively tried. Quinine holds its own with many practitioners; a sixth of a grain may be given three times a day for each month of age, and a grain and a half for each year in children under five. The use of benzoin inhalations is often helpful. For the catarrhal symptoms moderate doses of ipecac are probably the most satisfactory. Sedatives are by far the most trustworthy drugs in severe cases, and paregoric may be given freely, particularly to give rest at night. Codeia and heroin in doses proper for the age often give much relief. Jacobi advises belladonna in full doses, as much as one-sixth of a grain of the extract to a child of six or eight months three times a day. Children can often be taught to inhibit an attack.

Other remedies, such as antipyrin and chloral hydrate, may be tried. In older children and in adults it would be worth while, I think, to try the intratracheal injections of olive-oil and iodoform, which are sometimes so useful in allaying severe paroxysmal cough. The wearing of a tight abdominal binder is sometimes of value.

After the severity of the attack has passed and convalescence has begun, the child should be watched with the greatest care. It is just at this period that the fatal broncho-pneumonias are apt to develop. The cough sometimes persists for months and the child remains weak and delicate. Change of air should be tried. Such a patient should be fed with care and given tonics and cod-liver oil.

Inn sperm[illegible] ... mesent. bronchial glands may ...

organisms in [illegible]?

implement fixation test. about 2 weeks after onset.
Shiga ... [illegible]

Hg. Bv. agglutin. gener. 2 weeks after onset
organism not found [illegible]

even temp. protected from dust
moist vapor. + oil of eucalyptus or carbolic acid
(3i to pint)

(Vaccine as prophyl.)
under 1 yr. 250 - 500, 1000 millions
over 1 " - 500 - 1000 2000 "
injection at ~~3 day~~ 3 day
intervals

Carb. solution
others smaller doses.
20 mills - about 100 mills.
antipyrin gr i - ½ (0.0625 - 0.32 gm)
bromoform - 1-5 drops with care.

Stock vaccines. asprophylactic
also medicament.
rescue. not much use

Inhalations, benzoin.
oil eucalyptus

Convulsions = hot mustard bath
or ha...
per rectum of chloroform
chloral by rectum in warm fluid
1-2 yrs. 5-10 grains. Bromides
may be added.

until a foetal fluids appears in the chucks. [illegible] effect - see morphine
in [illegible]
Rectal [illegible]

The types described - correspond to adult & imbecile types of imbecility

X. GONOCOCCUS INFECTION

Definition.—An acute infection with a primary lesion, usually blennorrhagia, and numerous secondary and systemic manifestations, of which prostatitis and epididymitis, salpingitis, arthritis, synovitis and endocarditis are the most important. The *Micrococcus gonorrhœæ* (gonococcus) was described by Neisser, in 1879.

Gonorrhœa, one of the most widespread and serious of infectious diseases, presents many features for consideration. It is not a killing disease; only 89 fatal cases are recorded in the Registrar General's Report, 1899, for England and Wales, but as a cause of ill-health and disability the gonococcus occupies a position of the very first rank among its fellows. While the local lesion is too often thought to be trifling, in its singular obstinacy, in the possibilities of permanent sexual damage to the individual himself and still more in the "grisly troop" which may follow in its train, gonorrhœa does not fall very far short of syphilis in importance.

Etiology.—The organism is a biscuit-shaped micrococcus, occurring in pairs, usually within the leucocytes, and is always found in the primary and systemic lesions. ~~It is capable of cultivation, and~~ The disease has been reproduced by inoculation of the pure culture.

The disease is seen in men and women as a result of impure sexual intercourse, and in the new-born from vaginal contamination, and in older children by accidental infection. Ophthalmia neonatorum is one of the great causes of blindness, but an active campaign of education is rapidly reducing the number of cases.

The gonococcus vaginitis and the ophthalmia are very serious diseases in children's hospitals and in infants' homes. The story of the gonococcus infection in the Babies' Hospital, New York, for eleven years, as told by Holt (N. Y. Med. Jour., March, 1905), illustrates the singular obstinacy of the infection. In spite of the greatest care and precaution, there were, in 1903, 65 cases of vaginitis, with 2 of ophthalmia and 12 of arthritis. In 1904 there were 52 cases of vaginitis, only 16 of which would have been recognized without the bacteriological examination. In all, in the eleven years, there were 273 cases of vaginitis, only 6 with ophthalmia and 26 with arthritis. Other institutions have had equally sad experiences. Isolation and prolonged quarantine are the only measures to combat successfully the disease.

The immediate and remote effects of the gonococcus may be considered under—

I. The primary infection.

II. The spread in the genito-urinary organs by direct continuity.

III. Systemic gonococcus infection.

The primary lesion we need not here consider, but we may call attention to the frequency of the complications, such as periurethral abscess, gonorrhœal prostatitis in the male, and vaginitis, endocervicitis, and inflammation of the glands of Bartholini in the female.

Perhaps the most serious of all the sequels are those which result from **the spread** by direct continuity of tissue. Gonococcus salpingitis has been shown to be not infrequent. Metritis and ovaritis are also occasionally met

with, and peritonitis. The gonococcus has been found in pure culture in cases of acute general peritonitis. Equally important is the cystitis, which is probably much more frequently the result of a mixed infection than due to the gonococcus itself. There is some danger of extension upward through the ureters to the kidneys. The pyelitis, like the cystitis, is usually a mixed infection.

Systemic Gonococcus Infection.—(1) Gonococcus Septicæmia and Pyæmia.—Thayer and Blumer first cultivated the gonococci from the blood in a case in my wards, and the septicæmia has been thoroughly studied by them and by Cole, who has divided the cases into four groups: (1) Those with *endocarditis,* 11 of the 29 cases collected by him. The clinical features are those of malignant endocarditis; two of the cases recovered. (2) Cases with *local suppuration* and the general features of a *pyæmia*—of the six cases three died. The septicæmia associated with a small focus of suppuration may be very intense. I examined the body of a young man who ten days after the onset of urethritis had chills and high fever; he became profoundly toxæmic and died on the morning of the fourth day from the chill. There was a small prostatic abscess and a dark tarry fluid blood, unlike anything I have ever seen. (3) Cases *with no metastatic local affections* or perhaps only slight arthritis. In a remarkable case at the Johns Hopkins Hospital, three months after an acute gonorrhœa the patient had a fever resembling typhoid, which lasted seven weeks. Gonococci were cultivated from the blood. He recovered and, as Cole suggests, such cases are probably more common than we suspect. (4) Cases of *gonorrheal puerperal septicæmia,* of which several instances have been reported. Of the 29 cases in which the septicæmia was demonstrated by the cultivation of the organism from the blood, 12 died. The endocarditis will be considered later.

(2) Gonococcus Arthritis.—In many respects this is the most damaging, disabling, and serious of all the complications of gonorrhœa, occurring in from 2 to 5 per cent. of the cases. It occurs more frequently in males than in females; 43 to 7 in one series at the Johns Hopkins Hospital (Cole). In a series of 252 cases collected by Northrup, 230 were in males; 130 cases were between twenty and thirty years of age. It occurs, as a rule, during an acute attack of gonorrhœa. In 208 of Northrup's series there was a urethral discharge while in hospital. It may occur as the attack subsides, or even when it has become chronic. A gonorrhœal arthritis of great intensity may occur in a newly married woman infected by an old gleet in her husband. In women it is not always easy to find evidence of local infection. As a rule, many joints are affected. In an analysis by Cole and McCrae of the involvement of the joints in gonococcus arthritis and in rheumatic fever, the average number in the former was double that in the latter. In Northrup's series three or more joints were affected in 175 cases, one joint in 56 cases. It is peculiar in attacking certain joints which are rarely involved in rheumatic fever, as the sterno-clavicular, ~~the~~ inter-vertebral, ~~the~~ temporo-maxillary and sacro-iliac.

The *anatomical changes* are variable. The inflammation is often periarticular, and extends along the sheaths of the tendons. When effusion occurs in the joints it rarely becomes purulent. It has more commonly the characters of a synovitis. About the wrist and hand suppuration some-

2e Cayer [illegible]

times occurs in the sheaths. The gonococcus itself is present in the inflamed joint or in the peri-arthritic exudate, and may often be obtained in pure culture. Sometimes the cultures are negative. Mixed infection with staphylococci or streptococci is very rare.

Clinical Course.—Variability and obstinacy are the two most distinguishing features. The following are the most important clinical forms:

(*a*) *Arthralgic,* in which there are wandering pains about the joints, without redness or swelling. These persist for a long time.

(*b*) *Polyarthritic,* in which several joints become affected. The fever is slight; the local inflammation may fix itself in one joint, but more commonly several become swollen and tender. In this form cerebral and cardiac complications may occur.

(*c*) *Acute gonococcus arthritis,* in which a joint, usually the knee, becomes suddenly involved. The pain is severe, the swelling extensive, and due chiefly to peri-articular œdema. The general fever is not at all proportionate to the intensity of the local signs. The exudate usually resolves, though suppuration occasionally supervenes.

(*d*) *Chronic Hydrarthrosis.*—This is usually mono-articular, and is particularly apt to involve the knee. It comes on often without pain, redness, or swelling. Formation of pus is rare. It occurred only twice in 96 cases tabulated by Nolen.

(*e*) *Bursal and Synovial Form.*—This attacks chiefly the tendons and their sheaths and the bursæ and the periosteum. The articulations may not be affected. The bursæ of the patella, the olecranon, and the tendo Achillis are most apt to be involved.

(*f*) *Septicæmic.*—In which with an acute arthritis the gonococci invade the blood, and the picture is that of an intense septico-pyæmia, usually with endocarditis.

(*g*) The *Painful Heel of Gonorrhœa.*—This is a remarkable form of pododynia due to local periosteal thickening and exostosis on the os calcis, causing pain and great disability. Baer has demonstrated the gonococcus in the periosteal lesion.

Complications.—Iritis is not infrequent and may recur with successive attacks. The visceral complications are serious. Endocarditis, pericarditis, and pleurisy may occur.

Treatment.—The primary infection—usually urethritis—should be actively treated. Of special measures, the use of antigonococcus serum and vaccine treatment are worthy of trial; either will help some cases, both fail in many. Good food, fresh air, and open bowels are important. Drugs are of little value, especially sodium salicylate and potassium iodide. Phenacetine or aspirin may be given for the pain.

The local treatment is very important. In acute cases, fixation of the joints is very beneficial, and in the chronic forms, massage and passive motion. Counter-irritation by the cautery or blisters, active hyperæmia by baking or passive by the Bier method are all useful. A distended joint may be tapped and then tightly bandaged. The surgical treatment is more satisfactory in severe cases and good results usually follow incision and irrigation.

XI. BACILLARY DYSENTERY

Definition.—A form of intestinal flux, usually of an acute type, occurring sporadically and in severe epidemics, attacking children as well as adults, characterized by pain, frequent passages of blood and mucus, and due to the action of a specific bacillus, of which there are various strains.

Etiology.—Owing to improved sanitation, dysentery has become less frequent. In temperate climates sporadic cases occur from time to time, and at intervals epidemics prevail, particularly in overcrowded institutions. The statistics of general hospitals for the past twenty years show a decided increase in the number of cases admitted. Records of widespread epidemics have been collected by Woodward. The most serious was that which prevailed from 1847 to 1856. In Great Britain and Ireland epidemics of the disease have become less frequent. In institutions, particularly in overcrowded asylums, dysentery is very common, and this form has been made the subject of a valuable report by Mott and Durham. In the tropics "dysentery is a destructive giant compared to which strong drink is a mere phantom" (Macgregor). Dysentery is one of the great camp diseases, and it has been more destructive to armies than powder and shot. In the Federal service during the civil war, according to Woodward,* there were 259,071 cases of acute and 28,451 cases of chronic dysentery. The disease prevails in Porto Rico, the Philippines, and to a less extent in Cuba. In the South African campaign dysentery prevailed widely. For many years a very fatal form of dysentery has prevailed in Japan, particularly in the summer and autumn months, having a mortality of from 26 to 27 per cent.; in 1899 there were 125,989 cases, with 26,709 deaths (Eldridge). It is now generally conceded that the severe epidemics of acute dysentery occurring in the tropics are of the bacillary type, and the same form prevails in temperate climates.

Bacillus Dysenteriæ.—In 1898, Shiga, a Japanese observer, found in the dysentery prevailing in his country a bacillus with special characters, which he considered to be the specific cause of the disease.

Flexner and Barker, of the Johns Hopkins Commission for the Study of Tropical Diseases, found in the dysentery in the Philippine Islands an identical organism, and it has been made the subject of very careful study by Flexner, and also by R. P. Strong, Musgrave, and Craig, of the United States army. It has also been found in cases of dysentery from Porto Rico. The organism appears to be constantly present in the acute dysentery of the tropics. In Manila, according to Strong and Musgrave, of 1,328 cases, 712 were of the acute specific variety, 55 suspected specific cases, and 561 of amœbic dysentery. Kruse, in an outbreak at Laar, in Germany, in which 300 persons were attacked, has isolated an identical bacillus. Vedder and Duval demonstrated that sporadic cases in adults in Philadelphia, as well as epidemics of dysentery in the Lancaster County Asylum, Pennsylvania, and in the almshouse at New Haven, were due to this organism. Duval and Bassett demonstrated that certain forms of summer diarrhœas of infants were

* Medical and Surgical History of the War of the Rebellion, Medical, vol. ii. The most exhaustive treatise extant on intestinal fluxes—an enduring monument to the industry and ability of the author.

due to infection with *B. dysenteriæ*. The Rockefeller Institute conducted a collective investigation into the cause of infantile diarrhœas in Boston, New York, Philadelphia, and Baltimore. Several observers, under Flexner's direction, studied 412 cases and found the dysentery bacillus present in 279 or 63.2 per cent.

The strain of the bacillus most frequently found in the United States is the "Flexner-Harris" type. It is now conceded that a number of strains of the bacillus occur. This fact has been determined by the relative agglutinative power of immune serum upon the bacilli isolated, as well as by the action of the latter upon various sugars. The lesions produced by the different strains are identical. The organism agglutinates with the blood serum of cases with acute dysentery as well as with the serum of immunized animals.

Infection takes place by the mouth. The organisms are widely distributed by the fæces of persons suffering with the disease and also by dysentery "carriers." In institutions food and drink readily become contaminated. Possibly, too, the germs are distributed by flies and dust.

Morbid Anatomy.—In the acute cases, when death has occurred on the fourth to the seventh day, the mucous membrane of the large intestine is swollen, of a deep-red color, and presents elevated, coarse corrugations and folds. In addition to the intense hyperæmia there are spots of hæmorrhage scattered through the swollen mucosa. Over the surface there is usually a superficial necrotic layer, which can be brushed off lightly with the finger. This may be in patches, or uniform over large areas. There is no ulceration, only the superficial, general necrosis of the mucosa. The solitary follicles are swollen and red, but the prominence is obscured in the involvement of the entire mucosa. In cases of great intensity the entire coats of the colon may be stiff and thick, and the mucous membrane enormously increased in thickness, grayish black in color, extensively necrotic, and, in places, gangrenous. The serous surface is often deeply injected. The ileum is, in many cases, involved, having a deeply hæmorrhagic mucosa, with a superficial necrosis. In the subacute cases there is not the same great thickening of the intestinal wall, the solitary follicles are more swollen, there is less necrosis, and, while there are no ulcers, there are superficial erosions.

Symptoms.—According to Strong and Musgrave, the period of incubation is not more than forty-eight hours. The onset, which is usually sudden, is characterized by slight fever, pain in the abdomen, and frequent stools. At first mucus is passed, but within twenty-four hours blood appears with it, or there is pure blood. There is a constant desire to go to stool, with great straining and tenesmus; every hour or half hour there may be a small amount of blood and mucus passed. The temperature rises and may reach 103° or 104°. The pulse increases in frequency, and in the severer cases becomes very small. The tongue is coated with a white fur, and there is excessive thirst. In the very acute cases the patient becomes seriously ill within forty-eight hours, the movements increase in frequency, the pain is of great intensity, the patient becomes delirious, and death may occur on the third or fourth day. In cases of moderate severity the urgency of the symptoms abates, the stools lessen, the temperature falls, and within two or three weeks the patient is convalescent. The mortality in the severe forms is very high. There is a subacute form which lasts for many weeks or months. The

patients become greatly emaciated, having from three to five stools in the twenty-four hours. The *Bacillus dysenteriæ* is found in the stools, and it agglutinates readily with the blood serum.

Other Clinical Types.—The foregoing account describes the essential features of bacillary dysentery as seen in Japan, the Philippines, and the tropics. The clinical features of bacillary dysentery in adults in temperate climates differ in no essential manner from those already described. Although the evidence hardly warrants us at present in making the sweeping statement that all non-amœbic cases of dysentery are bacillary in origin, yet experience will probably demonstrate eventually that this is the case. What is known as the acute catarrhal dysentery is probably a sporadic form due to the *Bacillus dysenteriæ*. Diphtheritic dysentery is a type of the bacillary form with great necrosis and infiltration of the mucosa. There may be rapid gangrene and a fatal termination within twenty-four hours. A secondary diphtheritic dysentery is a common terminal event in many acute and chronic diseases, and a bacillus of the Shiga type has been isolated from these cases. Vedder and Duval have demonstrated that the bacillus is present in them.

Complications and Sequelæ.—*Peritonitis* is rare, due either to extension through the wall of the bowel or to perforation. When this occurs about the cæcal region, perityphlitis results; when low down in the rectum, periproctitis. In 108 autopsies collected by Woodward perforation occurred in 11. Abscess of the liver, so common in the amœbic form, is very rare. It is interesting to note, as illustrating the probable type of the disease, how comparatively rare abscess of the liver was during the American civil war. Very few cases occurred in the South-African War (Rolleston).

In the tropics malaria and acute dysentery very often coexist. With reference to typhoid fever, as a complication, Woodward mentions that the combination was exceedingly frequent during the civil war, and characteristic lesions of both diseases coexisted. In civil practice it is extremely rare.

Sydenham noted that dysentery was sometimes associated with rheumatic pains, and in certain epidemics joint swellings have been especially prevalent. They are not of the nature of rheumatic fever, but rather analogous to those of gonorrhœal arthritis. In severe cases there may be pleurisy, thrombosis, pericarditis, endocarditis, and occasionally pyæmic manifestations, among which may be mentioned pylephlebitis. Chronic nephritis is also an occasional sequel. In protracted cases there may be an anæmic œdema. An interesting sequel of dysentery is paralysis. Woodward reports 8 cases. Weir Mitchell mentions it as not uncommon, occurring chiefly in the form of paraplegia. As in other acute fevers, this is due probably to a neuritis. Remlinger, in two cases of non-amœbic dysentery in Tunis, observed an epididymitis during convalescence; Gonorrhœa was excluded. In a third case the dysentery was complicated by an abscess of the spleen, which ruptured, causing death. Intestinal stricture is a rare sequence—so rare that no case was reported at the Surgeon-General's office during the civil war. It appears to be not uncommon in the East. Among the sequelæ of chronic dysentery, in persons who have recovered a certain measure of health, may be mentioned persistent dyspepsia and irritability of the bowels.

Diagnosis.—In the acute specific form the blood serum agglutinates the dysentery bacillus. The "Flexner-Harris" type of the organism agglutinates

Mich. reactions may be added later

Kaolin by mouth in diarr. Hdgs. cholera-
Hdgs. i rehaustion, 12h. to begin 2 days
after the acute features are over the diet may be very [illegible]

mustin — enema

in dilutions of from 1 to 1,000 up to 1 to 1,500. ~~This is the form of the organism that prevails in the United States.~~ The "Shiga" type agglutinates less readily. The blood serum of a dysenteric patient will agglutinate both types, but the former more readily than the latter. In all non-amœbic dysenteries efforts should be made to isolate the dysentery bacillus from the stools.

Treatment.—Flint ~~has shown~~ that sporadic dysentery is, in its slighter grades at least, a self-limited disease, which runs its course in eight or nine days. Reading the report of his cases, one is struck, however, with their comparative mildness.

PROPHYLACTIC.—The same ~~prophylactic~~ precautions should be followed as are adopted in typhoid fever. Flexner and Gay have shown that animals can be protected from infection by a previous treatment with immune ~~horse~~ serum. Protective and curative serums have been prepared, ~~and are now on the market~~.

I. ACUTE DYSENTERY.—The patient should be absolutely at rest in bed. He should be kept warm and have a flannel abdominal binder applied. The diet should be very simple—whey, egg albumen, barley or rice water, and strained gruels. Enough water should be given to relieve thirst. If vomiting occurs, nothing should be given by mouth for some hours, and if the patient requires fluid this can be given by infusion. Hot applications to the abdomen are useful. If the patient is seen early in the attack, free purgation is advisable, for which sodium sulphate and Rochelle salts are best. Either may be given in doses of two drachms (8 gm.) for two doses an hour apart and later half the amount every three hours until the bowels have moved freely. By this treatment the course is sometimes cut short. If the attack is well established, the use of purgatives must be determined by the conditions present. If solid fæcal matter is being passed, a purgative is indicated, castor oil being the best (3 vi, 25 c. c.). Until the bowels have been thoroughly cleared, purgation is indicated.

Medicinal.—Bismuth in large doses often has a beneficial effect. Thirty to sixty grains (2 to 4 gm.) should be given every hour. Minute doses of bichloride of mercury, one hundredth of a grain every two hours, were recommended by Ringer. For the relief of pain and to quiet the bowel, morphia is the most useful drug and is to be preferred to opium by mouth. It should be given hypodermically in large doses (gr. 1-4 to 1-3, 0.016 to 0.022 gm.), and repeated according to the needs of the patient. If tenesmus is not marked, opium can be given as the starch and laudanum enema, in which thirty minims (2 c. c.) of laudanum are given. The ipecacuanha treatment is not so suitable for the bacillary as for the amœbic form, ~~with which it will be considered~~.

Local Treatment.—During the acute stages this may be out of the question, but should be employed whenever possible. Normal saline or sodium bicarbonate (1 per cent.) solution at the body temperature can be used. This should be given very gently and with the hips elevated. If there is rectal irritation, a cocaine or morphia suppository should be given beforehand. As the symptoms lessen, the quantity of fluid can be increased and other solutions used, such as boric acid (5 per cent.), salicylic acid (1 per cent.) or alum (1 to 200).

With convalescence the diet should be increased very gradually and only simple foods allowed. The patient should be kept quiet until all danger of a relapse is over. This is most important in the prevention of a chronic dysentery.

Serum Therapy.—Shiga produced a polyvalent serum by immunizing horses, by which he claims to have reduced the mortality in "endemic" dysentery in Japan from about 35 per cent. to 9 per cent. Good results have been reported from the use of the Pasteur Institute and Lister Institute serums, which should be given in doses of 20 c. c. two or three times a day.

II. Chronic Dysentery.—The patient should be at rest in bed and on simple diet, milk, boiled, peptonized or fermented, whey, beef juice, and eggs. In some cases milk may have to be given well diluted or in small amounts, but it usually agrees well. It is well to give an occasional purge (castor oil, ℥ ss, 15 c. c.) to empty the bowels. Drugs by mouth are not of great value. Bismuth, if used, should be in large doses (3 i, 4 gm.) every three hours while the patient is awake. Opium should not be given as a routine measure, as there is great danger of forming a habit. If employed, it is best given in the starch and laudanum enema.

Local Treatment.—This is most rational and should be carried out thoroughly. If the rectum is irritable, a cocaine or morphine suppository should be given half an hour previously. The irrigation, at the body temperature, should be given very gently, the patient encouraged to retain it as long as possible, and the amount gradually increased up to two litres if possible. One irrigation a day is usually enough. Silver nitrate solution is probably the best (1 to 5,000 at first and increased to 1 to 500). Boric acid (5 per cent.), salicylic acid (2 per cent.), alum, or tannic acid (3 per cent.) may also be used. With any of these an occasional irrigation of saline solution is useful. With improvement the frequency of the irrigations should be reduced. In the obstinate cases an appendicostomy may be done and the bowel irrigated through the opening.

XII. MALTA FEVER

(*Undulant Fever, Mediterranean Fever*)

Definition.—A specific fever, caused by the *Micrococcus melitensis*, characterized by undulatory pyrexial relapses, profuse sweats, rheumatic pains, arthritis, and an enlarged spleen. It is spread, as a rule, through the agency of goat's milk.

Distribution.—The disease prevails in the Mediterranean littoral, and endemic foci exist in India, Africa, China, and Manila. In the goat raising sections of Texas the disease is endemic (Gentry and Ferenbaugh). In the Malta garrison in the seven years 1898-1904, there were 2,229 cases, with an average case duration of one hundred and twenty days and with 77 deaths. About the same number of cases occurred in the fleet. Since the introduction of prophylactic measures the disease has practically disappeared from the Army and Navy, and has diminished greatly in the civil population.

Etiology.—The greater part of our knowledge of this remarkable disease we owe to the work of British army surgeons stationed at Gibraltar and Malta, particularly to Marston, Bruce, and Hughes. In 1886 Bruce isolated an or-

ulcus in bucc. applex silvi nitrati solutio (2,5 pro cent) to any which can
be reached -

ganism which he called *Micrococcus melitensis* from the spleen and blood. Hughes, Wright, Semple, and others confirmed this. In 1904-1905 a Government Commission began a study ~~on the island~~ of the problems of the disease in all its aspects. It was shown to be a septicæmia, due to the above-named organism, which had an unusually prolonged saprophytic existence. Zamit showed that the goats, the most important animals in the domestic life of Malta, were largely infected, from 10 to 15 per cent. having the micrococcus in their milk. Monkeys were successfully infected with milk which contained the organisms. Steps were at once taken to stop the use as far as possible of goat's milk for the troops, with the result that the number of cases fell from 750 in 1905 to 145 in 1906, and to 7 for nine months of 1907. There were no cases in 1907 in the Mediterranean fleet, and since this date the disease has disappeared in the garrison and in the fleet.

The micrococcus enters the system through the gastro-intestinal tract. Ross and Eyre think it may also be transmitted by mosquitoes. It produces a chronic septicæmia with enlargement of the spleen.

Symptoms.—There is no specific fever which presents the same remarkable group of phenomena. The period of incubation is from six to ten days. "Clinically the fever has a peculiar irregular temperature curve, consisting of intermittent waves or undulations of pyrexia, of a distinctly remittent character. These pyrexial waves or undulations last, as a rule, from one to three weeks, with an apyrexial interval lasting for two or more days. In rare cases the remissions may become so marked as to give an almost intermittent character to the febrile curve, clearly distinguishable, however, from the paroxysms of paludic infection. This pyrexial condition is usually much prolonged, having an uncertain duration, lasting for even six months or more. Unlike paludism, its course is not markedly affected by the administration of quinine. Its course is often irregular and even erratic in nature. This pyrexia is usually accompanied by obstinate constipation, progressive anæmia, and debility. It is often complicated with and followed by neuralgic symptoms referred to the peripheral or central nervous system, arthritic effusions, painful inflammatory conditions of certain fibrous structures, of a localized nature, or swelling of the testicles" (Hughes). There is a malignant type, in which the disease may prove fatal within a week or ten days; an undulatory type—the common variety—in which the fever is marked by intermittent waves or undulations of variable length, separated by periods of apyrexia and freedom from symptoms. In this really lie the peculiar features of the disease, and the unfortunate victim may suffer a series of relapses which may extend from three months, the average time, to two years. Lastly, there is an intermittent type, in which the patient may simply have daily pyrexia toward evening, without any special complications, and may do well and be able to go about his work, and yet at any time the other serious features of the disease may develop.

The blood serum of a patient with Malta fever agglutinates the *Micrococcus melitensis*. For diagnosis, cultures from the blood may be made or, if other procedures fail, from the spleen.

The mortality is slight, only about 2 per cent. There are no characteristic morbid lesions, but the spleen is enlarged, dark and soft. Malta fever can ~~now~~ be readily differentiated from typhoid fever and malaria. The *prophy-*

laxis is self-evident, and the brilliant work of the commission has already reduced the incidence of the disease to a minimum. The disease has disappeared from Gibraltar since the importation of goats from Malta has been stopped.

Treatment.—General measures suitable to typhoid fever are indicated. Fluid food should be given during the febrile period. Vaccines may be used and good results have been reported. Hydrotherapy, either the bath or the cold pack, should be used every third hour when the temperature is above 103° F. Otherwise the treatment is symptomatic. No drugs appear to have any special influence on the fever. A change of climate seems to promote convalescence.

XIII. CHOLERA ASIATICA

Definition.—A specific, infectious disease, caused by the comma bacillus of Koch, and characterized clinically by violent purging and rapid collapse.

Historical Summary.—Cholera has been endemic in India from a remote period, but only within the last century did it make inroads into Europe and America. An extensive epidemic occurred in 1832, in which year it was brought in immigrant ships from Great Britain to Quebec. It travelled along the lines of traffic up the Great Lakes, and finally reached as far west as the military posts of the upper Mississippi. In the same year it entered the United States by way of New York. There were recurrences of the disease in 1835-'36. In 1848 it entered the country through New Orleans, and spread widely up the Mississippi Valley and across the continent to California. In 1849 it again appeared. In 1854 it was introduced by immigrant ships into New York and prevailed widely throughout the country. In 1866 and in 1867 there were less serious epidemics. In 1873 it again appeared in the United States, but did not prevail widely. In 1884 there was an outbreak in Europe, and again in 1892 and 1893. Although occasional cases have been brought by ship to the quarantine stations of Great Britain and the United States, the disease has not gained a foothold in either country since 1873. It has prevailed continuously in the Philippines since 1901, but is now well under control. For the past ten years it has prevailed widely in the near and far East. Russia has suffered severely since 1907, but last year, 1911, there were comparatively few cases. In 1911 cholera prevailed in Italy, North Africa and Madeira. There were outbreaks in Asia Minor, Arabia and Turkey, and the usual prevalence in India. To the United States, during 1911, cholera was frequently conveyed by ships from Italy, but there was no difficulty in controlling it. A number of cholera "carriers" were found.

Etiology.—In 1884 Koch announced the discovery of the specific organism of this disease. Subsequent observations have confirmed his statement that the comma bacillus, as it is termed, occurs constantly in the true cholera, and in no other disease. It has the form of a slightly bent rod, which is thicker, but not more than about half the length of the tubercle bacillus, and sometimes occurs in corkscrew-like or S forms. The organisms grow upon a great variety of media and display distinctive and characteristic appearances. Koch found them in the water tanks in India, and they were isolated

from the Elbe water during the Hamburg epidemic of 1892. During epidemics virulent bacilli may be found in the fæces of healthy persons. The bacilli are found in the intestine, in the stools from the earliest period of the disease, and very abundantly in the characteristic rice-water evacuations, in which they may be seen as an almost pure culture. They very rarely occur in the vomit. Post mortem, they are found in enormous numbers in the intestine. In acutely fatal cases they do not seem to invade the intestinal wall, but in those with a more protracted course they are found in the depths of the glands and in the still deeper tissues. Experimental animals are not susceptible to cholera germs administered per os. But if introduced after neutralization of the gastric contents, and if kept in contact with the intestinal mucosa by controlling peristalsis with opium, guinea-pigs succumb after showing cholera-like symptoms. The intestines are filled with thin, watery contents, containing comma bacilli in almost pure culture.

Cholera Toxin.—Koch in his studies of cholera failed to find the spirilla in the internal organs. He concluded that the constitutional symptoms of the disease resulted from the absorption of toxic bodies from the intestine. R. Pfeiffer has shown that the cholera toxin is intimately associated with the protein of the bacterial cells, and, being of a very labile nature, can not be separated. Dead cultures are toxic; and the symptoms produced by the introduction of even minimal amounts are often comparable with those of the algid stage of cholera asiatica. The symptoms occur very rapidly, and death often results in eight to twelve hours; in non-fatal cases recovery is often equally as rapid. The intracellular cholera toxin is poisonous to animals if introduced into the blood, peritoneal cavity, or subcutaneous tissues. No absorption takes place from the intestine unless the epithelial layer has been injured.

Immunity.—Animals may be immunized by repeated injections of non-fatal doses of the dead and later of the living organisms. The serum of an animal thus immunized has a protective power when injected into a guinea pig along with five or ten times the fatal dose. This serum has also agglutinative and other antibacterial properties. The blood serum of convalescent patients also possesses these properties, and for therapeutic purposes anti-serums have been introduced and used widely in India, the Philippines and in Russia.

Modes of Infection.—As in other diseases, individual peculiarities count for much, and during epidemics virulent cholera bacilli have been isolated from the normal stools of healthy men. Cholera cultures have also been swallowed with impunity.

The disease is not highly contagious; physicians, nurses, and others in close contact with patients are not often affected. On the other hand, washerwomen and those who are brought into very close contact with the linen of the cholera patients, or with their stools, are particularly prone to catch the disease. There have been several instances of so-called "laboratory cholera," in which students, having been accidentally infected while working with the cultures, have taken the disease, and at least one death has resulted.

Vegetables which have been washed in the infected water, particularly lettuces and cresses, may convey the disease. Milk may also be contaminated. The bacilli live on fresh bread, butter, and meat, for from six to eight days. In regions in which the disease prevails the possibility of the infection of food

by flies should be borne in mind, since it has been shown that the bacilli may live for at least three days in their intestines.

Infection through the air is not to be much dreaded, since the germs when dried die rapidly.

The disease is propagated chiefly by contaminated water used for drinking, cooking, and washing. The virulence of an epidemic in any region is in direct proportion to the imperfection of its water-supply. In India the demonstration of the connection between drinking-water and cholera infection is complete. The Hamburg epidemic is a most remarkable illustration. The unfiltered water of the Elbe was the chief supply, although taken from the river in such a situation that it was of necessity directly contaminated by sewage. ~~It is not known accurately from what source the contagion came, whether from Russia or from France, but~~ In August, 1892, there was a sudden explosive epidemic, and within three months nearly 18,000 persons were attacked, with a mortality of 42.3 per cent. The neighboring city of Altona, which also took its water from the Elbe, but which had a thoroughly well-equipped modern filtration system, had in the same period only 516 cases.

Two main types of epidemics of cholera are recognized: the first, in which many individuals are attacked simultaneously, as in the Hamburg outbreak, and in which no direct connection can be traced between the individual cases. In this type there is widespread contamination of the drinking-water. In the other the cases occur in groups, so-called cholera nests; individuals are not attacked simultaneously, but successively. A direct connection between the cases may be very difficult to trace. ~~Again,~~ Both these types may be combined, and in an epidemic which has started in a widespread infection through water, there may be other outbreaks, ~~which are~~ examples of the second or chain-like type.

Cholera "carriers" have no doubt an important influence. In Manila nearly 8 per cent. of 376 healthy persons harbored the bacilli. The perennial outbreaks of this disease in the Manila prison were due to carriers, 17 of whom were found among those who had to do with the preparation of the food and drink of 3,000 prisoners.

The disease always follows the lines of human travel. In India it has, in many notable cases, been widely spread by pilgrims. It is carried also by caravans and in ships. It is not conveyed through the atmosphere.

Places situated at the sea-level are more prone to the disease than inland towns. In high altitudes the disease does not prevail so extensively. A high temperature favors the development of cholera, but in Europe and America the epidemics have been chiefly in the late summer and in the autumn.

The disease affects persons of all ages. It is particularly prone to attack the intemperate and those debilitated by want of food and by bad surroundings. Depressing emotions, such as fear, undoubtedly have a ~~marked~~ influence. It is doubtful whether an attack furnishes immunity against a second one.

Morbid Anatomy.—A post mortem diagnosis ~~of the nature~~ of the disease ~~could~~ be made by any competent bacteriologist, as the organism is distinctive. The body has the appearances associated with profound collapse. There is often marked post mortem elevation of temperature. The *rigor mortis* sets in early and may produce displacement of the limbs. The lower jaw has been

seen to move and the eyes to rotate. Various movements of the arms and legs have also been noted. The blood is thick and dark, and there is a remarkable diminution in the amount of its water and salts. The peritoneum is sticky, and the coils of intestines are congested and look thin and shrunken. The small intestine usually contains a turbid serum, similar in appearance to that which was passed in the stools. The mucosa is, as a rule, swollen, and in very acute cases slightly hyperæmic; later the congestion, which is not uniform, is more marked, especially about the Peyer's patches. Post mortem the epithelial lining is sometimes denuded, but this is probably not a change which takes place freely during life. In the stools, however, large numbers of columnar epithelial cells have been described by Horner and others. The bacilli are found in the contents of the intestine and in the mucous membrane. The spleen is usually small. The liver and kidneys show cloudy swellings, and the latter extensive coagulation-necrosis and destruction of the epithelial cells.

Symptoms.—A period of incubation of uncertain length, probably not more than from two to five days, precedes the onset of the symptoms.

Three stages may be recognized in the attack: the preliminary diarrhœa, the collapse stage, and the period of reaction.

(*a*) THE PRELIMINARY DIARRHŒA may set in abruptly without any previous indications. More commonly there are, for one or two days, colicky pains in the abdomen, with looseness of the bowels, perhaps vomiting, with headache and depression of spirits. There may be no fever.

(*b*) COLLAPSE STAGE.—The diarrhœa increases, or, without any of the preliminary symptoms, sets in with the greatest intensity, and profuse liquid evacuations succeed each other rapidly. There are in some instances griping pains and tenesmus. More commonly there is a sense of exhaustion and collapse. The thirst becomes extreme, the tongue is white; cramps of great severity occur in the legs and feet. Within a few hours vomiting sets in and becomes incessant. The patient rapidly sinks into a condition of collapse, the features are shrunken, the skin has an ashy-gray hue, the eyeballs sink in the sockets, the nose is pinched, the cheeks are hollow, the voice becomes husky, the extremities are cyanosed, and the skin is shriveled, wrinkled, and covered with a clammy perspiration. The temperature sinks. In the axilla or in the mouth it may be from five to ten degrees below normal, but in the rectum and in the internal parts it may be 103° or 104°. The blood pressure falls greatly and is often below 70 mm. Hg. The pulse becomes extremely feeble and flickering, and the patient gradually passes into a condition of coma, though consciousness is often retained until near the end.

The fæces are at first yellowish in color, from the bile pigment, but soon they become grayish-white and look like turbid whey or rice-water; whence the term "rice-water stools." There are found in them numerous small flakes of mucus and granular matter, and at times blood. The reaction is usually alkaline. The fluid contains albumin and the chief mineral ingredient is chloride of sodium. Microscopically, mucus and epithelial cells and innumerable bacteria are seen, the majority of the latter being the comma bacilli.

The condition of the patient is largely the result of the concentration of the blood consequent upon the loss of serum in the stools. The specific gravity of the blood rises to 1060 to 1072. There is almost complete arrest

of secretion, particularly of the saliva and the urine. On the other hand, the sweat-glands increase in activity, and in nursing women it has been stated that the lacteal flow is unaffected. This stage sometimes lasts not more than two or three hours, but more commonly from twelve to twenty-four.

(*c*) Reaction Stage.—When the patient survives the collapse, the cyanosis gradually disappears, the warmth returns to the skin, which may have for a time a mottled color or present a definite erythematous rash. The heart's action becomes stronger, the urine increases in quantity, the irritability of the stomach disappears, the stools are at longer intervals, and there is no abdominal pain. In the reaction the temperature may not rise above normal. Not infrequently this favorable condition is interrupted by a recurrence of severe diarrhœa and the patient is carried off in a relapse. Other cases pass into the condition of what has been called *cholera-typhoid*, a state in which the patient is delirious, the pulse rapid and feeble, and the tongue dry. Death finally occurs with coma. These symptoms have been attributed to uræmia.

During epidemics attacks are found of all grades of severity. There are cases of diarrhœa with griping pains, liquid, copious stools, vomiting, and cramps, with slight collapse. To these the term *cholerine* has been applied. They resemble the milder cases of *cholera nostras*. At the opposite end of the series there are the instances of *cholera sicca*, in which death may occur in a few hours after the onset, without diarrhœa. There are also cases in which the patients are overwhelmed with the poison and die comatose, without the preliminary stage of collapse.

Complications and Sequelæ.—~~The typhoid condition has already been referred to.~~ The consecutive nephritis rarely induces dropsy. Diphtheritic colitis has been described. There is a special tendency to diphtheritic inflammation of the mucous membranes, particularly of the throat and genitals. Pneumonia and pleurisy may follow, and destructive abscesses may occur in different parts. Suppurative parotitis is not very uncommon. In rare instances local gangrene may occur. A troublesome symptom of convalescence is cramps in the muscles of the arms and legs.

Diagnosis.—The only affection with which Asiatic cholera could be confounded is the *cholera nostras*, the severe choleraic diarrhœa which occurs during the summer months in temperate climates. The clinical picture of the two affections is identical. The extreme collapse, vomiting, and rice-water stools, the cramps, the cyanosed appearance, are all seen in the worst forms of cholera nostras. In enfeebled persons death may occur within twelve hours. It is of course extremely important to be able to diagnose between the two affections. This can only be done by one thoroughly versed in bacteriological methods, and conversant with the diversified flora of the intestines.

Attacks very similar to Asiatic cholera are produced in poisoning by arsenic, corrosive sublimate, and certain fungi; but a difficulty in diagnosis could scarcely arise.

The *prognosis* is always uncertain, as the mortality ranges in different epidemics from 30 to 80 per cent. Intemperance, debility, and old age are unfavorable conditions. The more rapidly the collapse sets in, the greater is the danger, and as Andral truly says of the malignant form, "It begins where other diseases end—in death." Patients with marked cyanosis and very low temperature rarely recover.

Prophylaxis.—Preventive measures are all-important, and isolation of the sick and thorough disinfection have effectually prevented the disease entering England or the United States since 1873. During epidemics the greatest care should be exercised in the disinfection of the stools and linen of the patients. When an epidemic prevails, persons should be warned not to drink water unless previously boiled. The milk should be boiled and all food and drinks carefully protected from flies. Errors in diet should be avoided. Uncooked vegetables and salads should not be eaten. As the disease is not more contagious than typhoid fever, the chance of a person passing safely through an epidemic depends very much upon how far he is able to carry out thoroughly prophylactic measures. Digestive disturbances are to be treated promptly, and particularly the diarrhœa, which so often is a preliminary symptom. For this, opium and acetate of lead and large doses of bismuth should be given. Protective inoculation has been carried out extensively in India by Haffkine and in the Philippines by Strong, in both places and recently in Russia with good results.

Treatment.—The patient should be at rest in bed, kept warm, and given simple diet, boiled milk, whey and egg albumen. The patient may be allowed to take water freely. If vomiting occurs food should be withheld and the stomach washed with an alkaline solution. Hot applications to the abdomen should be used and hot baths given if they prove helpful. Early in the course the bowels should be moved by castor oil or calomel. During the initial stage, when the diarrhœa is not excessive but the abdominal pain is marked, opium is the most efficient remedy, and it should be given hypodermically as morphia. It is advisable to give at once a full dose, which may be repeated on the return of the pain. It is best not to attempt to give remedies by the mouth, as they disturb the stomach. Ice should be given, and brandy or hot coffee. In the collapse stage, writers speak strongly against the use of opium. Undoubtedly it must be given with caution, but, judging from its effects in cholera nostras, I should say that collapse *per se* was not a contraindication.

Irrigation of the bowel with a solution of tannic acid (2 per cent.) in hot water (105°) should be used. With a long, soft-rubber tube, as much as two litres may be slowly injected. Not only is the colon cleansed, but the small bowel may also be reached, as shown by the fact that the tannic acid solutions have been vomited.

Owing to the profuse serous discharges the blood becomes concentrated, and absorption takes place rapidly from the lymph-spaces. To meet this, intravenous injections were introduced by Latta, of Leith, in the epidemic of 1832. My preceptor, Bovell, first practised the intravenous injections of milk in Toronto, in the epidemic of 1854.

Saline injections, intravenous and into the bowel, have been much used and with great success by the method introduced by Leonard Rogers. The hypertonic solution is composed of sodium chloride, grains 120; potassium chloride, grains 6; calcium chloride, grains 4; water, 1 pint. It is best given intravenously, particularly if the specific gravity of the blood is over 1063. As much as four pints may be injected slowly. It may be repeated and in one case as much as twenty pints were injected. In Calcutta the mortality has been reduced from 60 to about 33 per cent. in the cases treated by this

method and Rogers has had equally good results at Palermo in the summer of 1911.

In the stage of reaction special pains should be taken to regulate the diet and to guard against recurrences of the severe diarrhœa.

XIV. THE PLAGUE

Definition.—A specific, infectious disease, caused by *Bacillus pestis*, and occurring in two chief forms: a bubonic, involving the lymphatic glands, and a pneumonic, causing an acute and rapidly fatal inflammation of the lungs.

History and Geographical Distribution.—The disease was probably not known to the classical Greek writers. The earliest positive account dates from the second century of our era. The plague of Athens and the pestilence of the reign of Marcus Aurelius were apparently not this disease (Payne). From the great plague in the days of Justinian (sixth century) to the middle of the seventeenth century epidemics of varying severity occurred in Europe. Among the most disastrous was the famous "black death" of the fourteenth century, which overran Europe and destroyed a fourth of the population. In the seventeenth century it raged virulently, and during the great plague of London, in 1665, about 70,000 people died. During the eighteenth and nineteenth centuries the ravages of the disease lessened.

The revival of the plague is the most important single fact in modern epidemiology. Throughout the nineteenth century it waned progressively, outbreaks of some extent occurring in Turkey and Asia Minor and Astrakan; but we had begun to place it with sweating sickness and typhus among the diseases of the past. We knew that it slumbered in parts of China, and in northwest India, but the outbreak in 1894 at Hong-Kong startled the world and showed that the "black death" was still virulent. Since then it has spread in an ominous manner, reaching India, China, French Indo-China, Japan, Formosa, Australia, the Philippine Islands, South America, the West Indies, the United States, Cape Colony, Madagascar, Egypt, Asia Minor, and Russia in Asia. In Europe, cases have been carried to Marseilles and other Mediterranean ports and to Hamburg and Glasgow. In the latter city there was a small outbreak in 1900, 36 cases. In the next year there were two cases and in 1907 two cases—this without fresh importation. In San Francisco there was in 1907-1908 a recrudescence of the disease, and to March 15, 1908, there were 121 cases with 77 deaths. The rats are now (1911) no longer affected. The disease spread to the ground squirrels of the neighboring countries from which source eleven cases originated. The disease is now under control in both rats and squirrels.

In England there have been four sets of human cases in East Suffolk; at Shotley in 1906-07, 8 cases and 6 deaths; at Trimley, in December, 1909, and January, 1910, 8 cases and 5 deaths; at Freston in the autumn of 1910, 4 fatal cases; and a fourth case occurred in the autumn of 1911. The majority of these were of the pneumonic type. The serious feature is that there has been an infection of the rats in East Anglia, beginning in the region between Ipswich and the coast. The rats are entirely of the species *Mus decumanus* except in part of Ipswich. The infection is not very widespread,

as of 568 rats examined only 17 were found infected. The disease extended to rabbits, but not to any great extent. Some fleas from the rats were found to contain bacilli indistinguishable from plague. A much more extensive investigation of the prevalence of the plague in the rats of Suffolk and Essex was made by Petrie and Macalister; of 6,071 examined not one presented the appearance of plague. The disease has been introduced into Suffolk by ship rats from plague infected countries. More serious is the fact that ~~during the past three years~~ rats infected with the plague have been occasionally discovered at Wapping, but there does not seem to have been any widespread epidemic among them.

The immunity of the human population seems to be due to the fact that 50 per cent. of the rat fleas are of the variety *Pulex cheopis,* which rarely bites man, and the other rat flea, the *Ceratophyllus fasciatus,* does not bite man very freely. Then the common brown rat is not a house resident to any extent, so that conditions in England are not very favorable for epidemic prevalence.

The distribution in India is remarkable, chiefly in the Punjab, Bombay, and the United Provinces, which have a combined population of about 100 millions. In these three provinces between 1896 and the middle of 1911, about five and a half million deaths from plague have occurred. In the remaining provinces of India, with a population of some 200 millions, only about two millions of plague deaths have occurred. In the Presidency of Madras the disease has not been very severe, while Eastern Bengal and Assam have remained free, though cases have been repeatedly imported. During 1911 the returns for India for the first six months show 604,634 deaths. There have been recent outbreaks in China, a sharp outbreak in Hong-Kong, and the disease has been reported in Egypt, Japan, Straits Settlements, Java and Sumatra, Persia, Turkey in Asia, Astrakan, the Mauritius, and several of the South American countries. The Manchurian outbreak of pneumonic plague in the winter of 1810-11 was one of the most virulent on record, carrying off more than 4,500 persons in a few months.

Etiology.—The specific organism of the disease is a bacillus discovered by Kitasato. It resembles somewhat the bacillus of chicken cholera, and grows in a perfectly characteristic manner. *Bacillus pestis* occurs in the blood, in the organs of the body and in the sputum, and has also been found in the dust and in the soil of houses in which the patients have lived.

The disease prevails most frequently in hot seasons, though an outbreak may occur during the coldest weather. Persons of all ages are attacked. It spreads chiefly among the poor, in the slums of the great cities.

The following conclusions of the Plague Commission (1908) relate to bubonic plague: (*a*) Contagion occurs in less than 3 per cent. of the cases, playing a very small part in the general spread of the disease. (*b*) Bubonic plague in man is entirely dependent on the disease in the rat. (*c*) The infection is conveyed from rat to rat and from rat to man solely by means of the rat-flea. (*d*) A case in man is not in itself infectious. (*e*) A large majority of cases occur singly in houses. When more than one case occurs in a house, the attacks are generally nearly simultaneous. (*f*) Plague is usually conveyed from place to place by imported rat-fleas, which are carried by people on their persons or in their baggage. The human agent may

himself escape infection. (*g*) Insanitary conditions have no relation to the occurrence of plague, except in so far as they favor infestation by rats. (*h*) The non-epidemic season is bridged over by acute plague in the rat, accompanied by a few cases among human beings.

In the pneumonic form personal infection from one person to another is the common way, as the bacilli are sprayed into the air by coughing. The possibility of the human flea as a carrier must be considered.

Clinical Forms.—Pestis Minor.—In this variety, also known as the ambulant, the patient has a few days of fever, with swelling of the glands of the groin, and possibly suppuration. He may not be ill enough to seek medical relief. These cases, often found at the beginning and end of an epidemic, are a very serious danger, as the urine and fæces contain bacilli.

Bubonic Plague.—This constitutes the common variety, 77.65 per cent. of 11,600 cases of plague treated in the Arthur Road Hospital, Bombay (N. H. Choksy). The stage of invasion is characterized by headache, backache, stiffness of the limbs, a feeling of anxiety and restlessness, and great depression of spirits. There is a steady rise in the fever until the evening of the third or fourth day, when there is a drop of two or three degrees. There is then a secondary fever, as some writers describe it, in which the temperature reaches a still higher point. The tongue becomes brown, collapse symptoms are apt to supervene, and in very severe infections the patient may die at this stage. In at least two-thirds of all cases there are glandular swellings or buboes. An analysis of 9,500 cases of buboes gave more than 54 per cent. with the glands of the groin affected. The swelling appears usually from the third to the fifth day. Resolution may occur, or suppuration, or in rare cases gangrene. Suppuration is a favorable feature, as noted by De Foe in his graphic account of the London plague.

Petechiæ very commonly show themselves, and may be very extensive. These have been called the "plague spots," or the "tokens of the disease," and gave to it in the middle ages the name of the Black Death. Hæmorrhages from the mucous membranes may also occur; in some epidemics hæmoptysis has been especially frequent.

Septicæmic Plague.—In this, the most rapid form, the patient succumbs in three or four days with a virulent infection before the buboes appear. This form constituted 14.25 per cent. of the 11,600 cases. Hæmorrhages are common. The bacilli can be obtained from the blood.

Pneumonic Plague.—In the ordinary bubonic type, inflammation of the lungs is not an uncommon complication, but the true pneumonic plague begins abruptly with fever, shortness of breath, cough, and sometimes pain in the chest. The fever increases, the signs of the involvement of the lung occur early; there may be impaired resonance at both bases with harsh and tubular breathing; the sputum becomes bloody and stained and more fluid than in ordinary pneumonia. Cyanosis is an early feature; the pulse is small and rapid, the patient becomes profoundly prostrate; the spleen enlarges rapidly, as early as the second day, and a fatal result follows in from two to four days. Recovery is very rare.

In other varieties the chief manifestations may be in the skin and subcutaneous tissues, or in the intestines, causing diarrhœa and sometimes the features of typhoid fever.

Diagnosis.—At the early stage of an outbreak plague cases are easily overlooked, but if the suspicious cases are carefully studied by a competent bacteriologist, there is no disease which can be more positively identified. The San Francisco epidemic illustrates this. The nature of the cases was recognized by Kellog and by Kinyoun, but with an amazing stupidity (which was shared by not a few physicians, who should have known better) the Governor of the State refused to recognize the presence of plague, and the United States Government had to intervene and send a board of experts to settle the question. In the early Glasgow cases Colvin, while suspecting typhoid fever, saw that there was something unusual, and at once took precautionary measures. Probably, too, the association of four cases in one family made him suspicious. The limitation of the outbreak was due to the prompt and effective measures taken by A. K. Chalmers and his associates. The widespread prevalence of the disease makes it the imperative duty of the health authorities to have on hand, in connection with large ports, skilled men who can promptly make the bacteriological diagnosis. There are dangers from the cultures in laboratories, ~~as shown~~ by the experiences of Vienna and Ann Arbor, but with proper precautions they may be reduced to a minimum. Acute, rapidly fatal pneumonia should arouse suspicion as in the Suffolk cases.

Prophylaxis.—Wherever plague exists an organized staff, an intelligent policy, and a long purse are needed. In India, where fifteenth-century conditions prevail, and where the scale of the epidemic is so enormous, the problem of prophylaxis looks hopeless. Simpson's recommendation of a specially trained plague service, organized on proper lines and on a liberal basis, should be carried out. A careful watch should be kept on the mortality of rats. When found infected, energetic measures should be taken to stamp out the disease in them. Three things are necessary—the cleansing of premises, particularly stables and outhouses, so that the rats cannot find nesting places or food; systematic rat destruction; and making houses rat proof. Certain measures prevent the access of plague to healthy ports; fumigation of ships to destroy the rats, careful inspection of passengers and crew, and detention over a period which covers the incubation of the disease.

When a centre becomes infected, the sanitary organization ~~should be arranged to~~ carry out the segregation of the sick in hospitals, the disinfection of infected rooms with sulphur, destruction of infected bedding, and thorough cleansing of the entire district; old, badly infected buildings should be destroyed.

Treatment.—In a disease the mortality of which may reach as high as 80 or 90 per cent. the question of treatment resolves itself into making the patient as comfortable as possible, and following out certain general principles such as guide us in the care of fever patients. Cantlie recommends purgation and stimulation from the outset, and the use of morphia for the pain. The local treatment of the buboes is important. Ice may be applied to them, and good results apparently follow the injection of the bichloride of mercury. The pyrexia of the disease is best treated by systematic hydrotherapy.

A plague serum, chiefly the Lustig and the Yersin-Roux, has been used. Choksy concludes that a reduction of 20-25 per cent. in the mortality may be obtained by its use.

Preventive Inoculation.—With Haffkine's serum in 12 districts, of 224,228 persons inoculated, 3,399 took the disease; of 639,600 uninoculated, 49,430 were attacked. C. J. Martin concludes that the chances of subsequent infection are reduced four-fifths, and the chances of recovery are two and a half times as great as in the case of the uninoculated. The recent reports from India are most favorable and in South America the value of this plan has been amply demonstrated. It is interesting to note that the laboratory staff at Bombay, 116 in number, have remained immune though in constant contact with plague infested rats.

XV. TETANUS

(*Lockjaw*)

Definition.—An infectious malady characterized by tonic spasms of the muscles with marked exacerbations. The virus is produced by a bacillus, *B. tetani* of Nicolaier, which occurs in earth, in putrefying fluids, and manure, and is a normal inhabitant of the intestines of many ruminants.

Etiology.—In the United States, according to Anders and Morgan, it is most frequent in the Hudson valley, in Long Island and in the Atlantic States. In 1909 there were 1,373 deaths from tetanus among 732,528 deaths in eighteen states; of which 30.7 per cent. were in children under one year. An extraordinary number of cases have followed the accidents of the July 4th celebrations, but the propaganda of the Journal of the American Medical Association has succeeded in reducing these fatalities in a remarkable way.

In England the disease is not very common, ~~but has increased of late years~~. There were only 2,124 deaths in the twenty year period ending 1908. It is more prevalent in certain districts, e. g. the Thames valley. It is more frequent in the Radcliffe Infirmary, Oxford, than in any hospital with which I have been connected. It is more common in the summer months and males are more frequently attacked than females. In E. W. Hill's analysis of 3,038 cases in temperate climates 22.31 per cent. were in children under one year, 21 per cent. in the third and fourth decades.

In the tropics tetanus is a much more severe and common disease. In Jamaica and Cuba it is from five to six times more frequent as a cause of death than in the United States, and above 80 per cent. of the deaths are in infants. In the Canal Zone the disease has not been common, only 25 cases have been admitted to the Ancon and Colon Hospital (E. W. Hill) to 1910. It is not only in the tropics that tetanus is a very fatal disease in infants. On an island near Iceland all the children born died; and for years the island of St. Kilda, one of the Western Hebrides, had been scourged by the "eight days sickness" among the new born. Of 125 children, 84 died within fourteen days of birth. Since ~~the discovery of the bacillus and~~ the introduction of proper methods of treating the umbilical cord the disease has practically disappeared.

The tetanus bacillus has contaminated vaccines, and its presence in commercial gelatine is a grave danger. Owing to the careless preparation of the virus many cases of tetanus occurred in the neighborhood of Philadelphia in 1901 among vaccinated children. In 1902 nineteen persons who had been

new figures.

1915. 156 deaths. (note. only comparable with years since 1902)

Smallest no. on record since 1902.

average for 10 previous years 211.6.

inoculated against the plague in the village of Mulkowal died of tetanus, owing to accidental contamination of the cultures. Outbreaks have occurred in general hospitals following the use of catgut. The disease has occurred after prolonged use of the hypodermic needle to inject morphia or quinine, and it has followed the use of gelatine as a hæmostatic.

The disease usually follows an injury, often of a most trifling character, and particularly lacerated wounds of the hands which have been contaminated by dirt and splinters. It may occur without any recognizable wound, so-called idiopathic tetanus.

The Tetanus Bacillus.—The organism is widely diffused in nature, in garden mould, in and about stables and farmyards, and is a normal inhabitant of the intestines of many horses and of the herbivora. The disease has been produced by inoculating animals with garden earth. Living bacilli occur in the intestines of 5 per cent. of healthy men and up to 20 per cent. of ostlers and dairymen. It is a slender motile bacillus, one end of which is swollen and occupied by a spore. It is anaerobic and grows at ordinary temperatures. The spores are the most resistant known. From two steel nibs dipped in a tetanus culture in 1891 a growth of virulent bacilli was obtained from one in 1902 and from the other in 1909 (Semple). The toxin is perhaps the most virulent of known poisons. Whereas the fatal dose of strychnine for a man weighing 70 kilos is from 30 to 100 milligrammes, that of the tetanus toxin is estimated at 0.23 milligramme. Every feature of the disease can be produced by it experimentally without the presence of the bacilli. The symptoms do not arise immediately, as in the case of ordinary poisons, but slowly, and it has been found to be absorbed by the end plates in the muscles and to pass up the motor nerves to the spinal cord. What we speak of as the period of incubation is the time required for the toxins to travel along the nerves to the centres. A high degree of antitoxic immunity can be conferred on animals, which then yield a protective serum. It is, however, difficult to cure animals with this serum on account of the combination of the toxin with nerve-cells by the time symptoms appear.

Morbid Anatomy.—No characteristic lesions have been found in the cord or in the brain. Congestions occur in different parts, and perivascular exudations and granular changes in the nerve-cells have been found. The condition of the wound is variable. The nerves are often found injured, reddened, and swollen. In tetanus neonatorum the umbilicus may be inflamed.

Symptoms.—The incubation period is from one to twenty days. Of 1,092 cases analyzed by E. W. Hill, in 17.49 per cent. it was from one to five days and in 55.06 per cent. from five to ten days. In only 8 cases was the incubation as long as twenty days. The patient complains at first of slight stiffness in the neck, or a feeling of tightness in the jaws, or difficulty in mastication. Occasionally chilly feelings or actual rigors may precede these symptoms. Gradually a tonic spasm of the muscles of these parts produces the condition of trismus or lockjaw. The eyebrows may be raised and the angles of the mouth drawn out, causing the so-called sardonic grin—*risus sardonicus*. In children the spasm may be confined to these parts. Sometimes the attack is associated with paralysis of the facial muscles and difficulty in swallowing—the head-tetanus of Rose, which has most commonly followed injuries in the neighborhood of the fifth nerve. Gradually the proc-

ess extends and involves the muscles of the body. Those of the back are most affected, so that during the spasm the unfortunate victim may rest upon the head and heels—a position known as *opisthotonos.* The rectus abdominis muscle has been torn across in the spasm. The entire trunk and limbs may be perfectly rigid—*orthotonos.* Flexion to one side is less common—*pleurothotonos;* while spasm of the muscles of the abdomen may cause the body to be bent forward—*emprosthotonos.* In very violent attacks the thorax is compressed, the respirations are rapid, and spasm of the glottis may occur, causing asphyxia. The paroxysms last for a variable period, but even in the intervals the relaxation is not complete. The slightest irritation is sufficient to cause a spasm. The paroxysms are associated with agonizing pain, and the patient may be held as in a vise, unable to utter a word. Usually he is bathed in a profuse sweat. The temperature may remain normal throughout, or show only a slight elevation toward the close. In other cases the pyrexia is marked from the outset; the temperature reaches 105° or 106° F., and before death 109° or 110° F. In rare instances it may go still higher. The course is sometimes very rapid, with fever and general spasms; death may take place on the third day. Death either occurs during the paroxysm from heart-failure or asphyxia, or is due to exhaustion.

The cephalic tetanus (*Kopftetanus* of Rose) originates usually from a wound of the head, and is characterized by stiffness of the muscles of the jaw and paralysis of the facial muscles on the same side as the wound, with difficulty in swallowing. There may be no other symptoms. This form has been called hydrophobic because of the spasm of the throat. The prognosis is good in the chronic cases; of those in Willard's table only 8 of 32 died; but in the acute form, of 45 cases, only 4 recovered.

Tetanus neonatorum.—This is a very common form, particularly in hot climates and in districts where the tetanus bacillus is very prevalent, as in the island of St. Kilda. The infection follows imperfect treatment of the navel. The symptoms may come on in a few days or be delayed for ten days. Trismus and difficulty in crying and taking food are the earliest symptoms, followed in a few days by more general spasms. It is a very fatal form. A form known as *visceral tetanus* is described by the French in which the disease originates in the intestines, and the possibility of this must be considered, as the spores have been found in human fæces. *Post-operative tetanus* occurs particularly after peritoneal operations. Paterson collected 150 cases in a large proportion of which catgut had been used. It is a very fatal form, with a short incubation and rapid course.

Diagnosis.—Well-marked cases following a trauma could not be mistaken for any other disease. The spasms are not unlike those of strychnia-poisoning, and in the celebrated Palmer murder trial this was the plea for the defence. The jaw-muscles, however, are never involved early, if at all, and between the paroxysms in strychnia-poisoning there is no rigidity. In tetany the distribution of the spasm at the extremities, the peculiar position, the greater involvement of the hands, and the condition under which it occurs are sufficient to make the diagnosis clear. In doubtful cases cultures should be made from the pus of the wound.

Escherich has described in children a form of generalized tonic contractures of the muscles of the jaw, neck, back, and limbs, usually a sequel of

chronic = slight symptoms - resistance -

hydrophobia

mild trismus from local disease, curable

2000 units per week to [illegible]

Subcutaneous injection.
general anesthesia
-

Nicoll.

3000–5000 units Spinal canal. 1 repeat in 24 hours
10000 units intravenously.
1000 " subcutaneously in 3 or 4 days

Subcutaneous -
Intramuscular. [illegible]

some acute infection, occasionally occurring as an independent malady. The contractures may be either intermittent or persistent. The condition may last from a week to a couple of months. The cases as a rule recover.

Prognosis.—Two of the Hippocratic aphorisms express tersely the general prognosis even at the present day: "The spasm supervening on a wound is fatal," and "such persons as are seized with tetanus die within four days, or if they pass these they recover." Of 1,264 cases analyzed by E. W. Hill only 414 recovered. If the disease lasts beyond the tenth day the patient has an even chance, and from this time the prognosis improves.

The mortality is greatest in children. Favorable indications are: late onset of the attack, localization of the spasms to the muscles of the neck and jaw, and an absence of fever.

Prophylaxis.—Suspicious wounds should be freely opened, thoroughly disinfected by hydrogen peroxide and cauterized with pure carbolic acid. In districts where the disease prevails, as in the Thames valley, special precautions should be taken with all injuries, and a prophylactic dose of antitetanic serum (500 to 1,000 units) administered. The experience in the United States with this treatment in the Fourth of July accidents has been most satisfactory. It should be carried out promptly in all street and infected injuries. As the serum is expensive, Boards of Health should arrange, if necessary, to provide it.

Treatment.—The patient should be kept in a darkened room, absolutely quiet, and attended by only one person. All possible sources of irritation should be avoided. Veterinarians appreciate the importance of this complete seclusion in treating horses.

When the lockjaw is extreme the patient may not be able to take food by the mouth, under which circumstances it is best to use rectal injections, or to feed by a catheter passed through the nose. The spasm should be controlled by chloroform, which may be repeatedly exhibited at intervals. It is more satisfactory to keep the patient thoroughly under the influence of morphia given hypodermically. Chloral hydrate, chloretone, bromide of potassium, Calabar bean, curare, Indian hemp, belladonna, and other drugs have been recommended, and recovery occasionally follows their use. Intraspinal injections of a solution of magnesium sulphate (25 per cent.) have been used (Meltzer); 1 c. c. is injected for every 25 pounds weight of the patient. Resection of the nerve and amputation of the limb have been advised. Although tetanus antitoxin of great strength can be obtained, its use in the treatment of human tetanus very often fails because it is given too late. Given at once and in sufficient doses, it should prove a specific. Large doses may be given, as much as 1,500 to 3,000 units every three or four hours. As many as 112,000 units have been given in a single successful case. The best results are obtained in the subacute cases, but here the prognosis is relatively favorable even with other methods of treatment.

Caffrey of Milwaukee
J.A.M.A. June 5. 1909. Vol LII
p. 1643

XVI. GLANDERS

(*Farcy*)

Definition.—An infectious disease of the horse and ass, caused by *Bacillus mallei,* communicated occasionally to man. In the horse it is characterized by the formation of nodules, chiefly in the nares (glanders) and beneath the skin (farcy).

Etiology.—The disease belongs to the infective granulomata. The local manifestations in the nostrils and the skin of the horse are due to ~~one and~~ the same cause. The specific germ was discovered by Loeffler and Schutz. It is a short, non-motile bacillus, not unlike that of tubercle, but exhibits different staining reactions. It grows readily on the ordinary culture media. For the full recognition of glanders in man we are indebted to the labors of Rayer, whose monograph remains one of the best descriptions ever given of the disease. Man becomes infected by contact with diseased animals, and usually by inoculation on an abraded surface of the skin. The contagion may also be received on the mucous membrane. In a Montreal case a gentleman was probably infected by the material expelled from the nostril of his horse, which was not suspected of having the disease. It is a rare disease. Only 4 deaths were registered from this cause in England and Wales in 1909. Among laboratory workers the *Bacillus mallei* has caused more deaths than any other germ, and in working with it the greatest possible precautions should be taken.

Morbid Anatomy.—As in the horse, the disease may be localized in the nose (glanders) or beneath the skin (farcy). The essential lesion is the granulomatous tumor, characterized by the presence of numerous lymphoid and epithelioid cells, among and in which are seen the glanders bacilli. These nodular masses tend to break down rapidly, and on the mucous membrane result in ulcers, while beneath the skin they form abscesses. The glanders nodules may also occur in the internal organs.

Symptoms.—An acute and a chronic form of glanders may be recognized in man, and an acute and a chronic form of farcy.

Acute Glanders.—The period of incubation is rarely more than three or four days. There are signs of general febrile disturbance. At the site of infection there are swelling, redness, and lymphangitis. Within two or three days there is involvement of the mucous membrane of the nose, the nodules break down rapidly to ulcers, and there is a muco-purulent discharge. An eruption of papules, which rapidly become pustules, breaks out over the face and about the joints. It has been mistaken for variola. In a Montreal case this copious eruption led the attending physician to suspect smallpox, and the patient was isolated. There is a great swelling of the nose. The ulceration may go on to necrosis, in which case the discharge is very offensive. The lymph glands of the neck are usually much enlarged. Subacute pneumonia is very apt to occur. This form runs its course in about eight or ten days, and is invariably fatal. *Glanders pneumonia* may appear after subcutaneous infection (one case from infection with a hypodermic syringe stuck into the thumb). Grossly the lung appeared like a caseous pneumonia.

3 deaths in 1914. 0 in 1915.

Camp. Newlin - Pattsburgh. Nov. 13.

Superficial smallpox pustules - umbilicated
red areola around them - sometimes before 2 weeks.
Diagnosis hesitated for some days -
Dr. Davis called in to
decide if smallpox -
very few on face. They were
chiefly on trunk & extremities

Sometimes an exanthem like measles
gangrene of [illegible]

Glanders to [illegible]

Diagnosis - bacilli in [illegible] injection of guinea pig
syphilis may be [illegible] in chronic cases.

serum -
precipitin test - antigen "malleasi" - to blood serum.
[illegible] of white corpuscles.

complement fixation - [illegible]

[illegible]

CHRONIC GLANDERS is rare and difficult to diagnose, as it is usually mistaken for a chronic coryza. There are ulcers in the nose, and often laryngeal symptoms. It may last for months, or even longer, and recovery sometimes takes place. Tedeschi has described a case of chronic osteomyelitis, due to the *Bacillus mallei,* which was followed by a fatal glanders meningitis. The diagnosis may be extremely difficult. In such cases a suspension of the secretion, or of cultures upon agar-agar made from the secretion, should be injected into the peritoneal cavity of a male guinea-pig. At the end of two days, in positive cases, the testicles are found to be swollen and the skin of the scrotum reddened. The testicles continue to increase in size, and finally suppurate. Death takes place after the lapse of two or three weeks, and generalized glanders nodules are found in the viscera. The use of mallein for diagnostic purposes is highly recommended. The principles and methods of application are the same as for tuberculin. McFadyean and others have shown that, while the glanders bacilli are agglutinated in a dilution of 1 to 200 by normal horse serum, that of a glanders horse will agglutinate at 1 to 1,000. The test must be made before mallein is given.

ACUTE FARCY in man results usually from the inoculation of the virus into the skin. There is an intense local reaction with a phlegmonous inflammation. The lymphatics are early affected, and along their course there are nodular subcutaneous enlargements, the so-called farcy buds, which may rapidly go on to suppuration. There are pains and swelling in the joints, and abscesses may form in the muscles. The symptoms are those of an acute infection, almost like an acute septicæmia. The nose is not involved and the superficial skin eruption is not common. The bacilli have been found in the urine in acute cases in man and animals.

The disease is fatal in a large proportion of the cases, usually in from twelve to fifteen days.

CHRONIC FARCY is characterized by the presence of localized tumors which break down into abscesses, and sometimes form deep ulcers, without much inflammatory reaction and without special involvement of the lymphatics. The disease may last for months or even years. Death may result from pyæmia, or occasionally acute glanders develops. The celebrated French veterinarian Bouley had it and recovered.

The disease is transmissible also from man to man. Washerwomen have been infected from the clothes of a patient. In the diagnosis of this affection the occupation is very important. Nowadays, in cases of doubt the inoculation should be made in animals, as in this way the disease can be readily determined. Mallein, a product of the growth of the bacilli, is now used for the purpose of diagnosing glanders in animals. Several instances of cured glanders have been reported in animals treated with small and repeated doses of mallein (Pilavios, Babes).

Treatment.—If seen early, the wound should be either cut out or thoroughly destroyed by caustics and an antiseptic dressing applied. The farcy buds should be early opened. In the acute cases there is very little hope. In the chronic cases recovery is possible, though often tedious.

Vaccine (20 millia. hypod. injection) at 4 day intervals.
Irrigation of ulcers with antiseptic soln. boric acid, pot. perm., hydrogen peroxide. Inhalations of benzoin, oil of eucalyptus

XVII. ANTHRAX

(*Splenic Fever; Charbon; Wool-sorter's Disease*)

Definition.—An acute infectious disease caused by *Bacillus anthracis*, occurring in three forms, cutaneous (malignant pustule), pulmonary, and intestinal. In animals, particularly in sheep and cattle, the disease has the character of an acute septicæmia with enlargement of the spleen—hence the name *splenic* fever. In man it occurs sporadically or as a result of accidental inoculations with the virus.

Etiology.—The infectious agent is a non-motile, rod-shaped organism, *Bacillus anthracis*, which has, by the researches of Pollender, Davaine, Koch, and Pasteur, become the best known perhaps of all pathogenic microbes. The bacillus has a length of from 2 to 25 μ; the rods are often united. The bacilli themselves are readily destroyed, but the spores are very resistant, and survive after prolonged immersion in a 5-per-cent. solution of carbolic acid, or withstand for some minutes a temperature of 212° F. They are capable also of resisting gastric digestion. Outside the body the spores are in all probability very durable.

In Animals.—Geographically and zoölogically the disease is the most widespread of all infections. It is much more prevalent in Europe and in Asia than in America. Its ravages among the herds of cattle in Russia and Siberia, and among sheep in certain parts of Europe, are not equalled by any other animal plague. In the United States anthrax is not very widespread. In France from 6 to 10 per cent. of the sheep and about 5 per cent. of the cattle formerly died of it.

The disease is conveyed sometimes by direct inoculation, as by the bites and stings of insects, by feeding on carcasses of animals which have died of the disease, but more commonly by grazing in pastures contaminated by the germs. Pasteur thought that the earthworm played an important part in bringing to the surface and distributing the bacilli ~~which had been propagated in~~ the buried carcass of an infected animal. Certain fields, or even farms, may thus be infected for an indefinite period ~~of time~~. It seems probable, however, that, if the carcass is not opened or the blood spilt, spores are not formed in the buried animal and the bacilli quickly die.

In man the disease does not occur spontaneously. It results always from infection, either through the skin or intestines, or in rare instances through the lungs. Workers in wool and hair, and persons whose occupations bring them into contact with animals or animal products, as stablemen, shepherds, tanners, and butchers, are specially liable to the disease. In the United States the disease is usually found in the workers in hides, in butchers, and in veterinarians. It is rare in general hospital work. There was only one case in sixteen years at the Johns Hopkins Hospital. In England and Wales in 1909 there were 15 deaths from this cause in man. Ponder states that 40 per cent. of all the cases of anthrax in British leather workers are due to handling Chinese or East Indian goods; 80 per cent. of the cases are malignant pustule from skin infection while handling hides at the docks or in the tanneries.

from

1915. 2d death.

There is remarkable freedom from pain.

The absence of pain distinguishes it from furuncle, carbuncle and cellulitis

Various forms of the disease have been described, and two chief groups may be recognized: the external anthrax and the internal anthrax, of which there are pulmonary and intestinal forms.

Symptoms.—(*a*) EXTERNAL ANTHRAX.—(1) *Malignant Pustule.*—At the site of inoculation, usually on an exposed surface—the hands, arms, or face—there are, within a few hours, itching and uneasiness, and the gradual formation of a small papule, which soon becomes vesicular. Inflammatory induration extends around this, and within thirty-six hours at the site of inoculation there is a dark brownish eschar, at a little distance from which there may be a series of small vesicles. The brawny induration may be extreme. The œdema produces very great swelling of the parts. The inflammation extends along the lymphatics, and the neighboring lymph-glands are swollen and sore. The fever at first rises rapidly, and the concomitant phenomena are marked. Subsequently the temperature falls, and in many cases becomes subnormal. Death may take place in from three to five days. In cases which recover the constitutional symptoms are slighter, the eschar gradually sloughs out, and the wound heals. The cases vary much in severity. In the mildest form there may be only slight swelling. At the site of inoculation a papule is formed, which rapidly becomes vesicular and dries into a scab, which separates in the course of a few days.

(2) *Malignant Anthrax Œdema.*—This form occurs in the eyelid, and also in the head, hand, and arm, and is characterized by the absence of the papule and vesicle forms, and by the most extensive œdema, which may follow rather than precede the constitutional symptoms. The œdema reaches such a grade of intensity that gangrene results, and may involve a considerable surface. The constitutional symptoms then become extremely grave, and the cases invariably prove fatal.

The greatest fatality is seen in cases of inoculation about the head and face, where the mortality, according to Nasarow, is 26 per cent.; the least in infection of the lower extremities, where it is 5 per cent.

In a case at the Johns Hopkins Hospital in 1895, in a hair-picker, there were most extensive enteritis, peritonitis, and endocarditis, which last lesion has been described by Eppinger.

A feature in both these forms of malignant pustule, ~~to which many writers refer~~, is the absence of feeling of distress or anxiety on the part of the patient, whose mental condition may be perfectly clear. He may be without any apprehension, even though the condition be most critical.

The *diagnosis* in most instances is readily made from the character of the lesion and the occupation of the patient. When in doubt, the examination of the fluid from the pustule may show the presence of the anthrax bacilli. Cultures should be made, or a mouse or guinea-pig inoculated from the local lesion. It is to be remembered that the blood may not show the bacilli in numbers until shortly before death.

(*b*) INTERNAL ANTHRAX.

(1) *Intestinal Form, Mycosis Intestinalis.*—In these cases the infection usually is through the stomach and intestines, and results from eating the flesh or drinking the milk of diseased animals; it may, however, follow an external infection if the germs are carried to the mouth. The symptoms are those of intense poisoning. The disease may set in with a chill, followed

by vomiting, diarrhœa, moderate fever, and pains in the legs and back. In acute cases there are dyspnœa, cyanosis, great anxiety and restlessness, and toward the end convulsions or spasms of the muscles. Hæmorrhage may occur from the mucous membranes. Occasionally there are on the skin small phlegmonous areas or petechiæ. The spleen is enlarged. The blood is dark and remains fluid for a long time after death. Late in the disease the bacilli may be found in the blood.

This is one of the forms of acute poisoning which may affect many individuals together. Thus, Butler and Karl Huber describe an epidemic in which twenty-five persons were attacked after eating the flesh of an animal which had had anthrax. Six died in from forty-eight hours to seven days.

(2) *Wool-sorter's Disease, Pulmonary Anthrax, Anthracæmia.*—This important form occurs in the large establishments in which wool or hair is sorted and cleansed. The hair and wool imported into Europe from Russia and South America appear to have induced the largest number of cases. Many of these show no external lesion. The infective material has been swallowed or inhaled with the dust. There are rarely premonitory symptoms. The patient is seized with a chill, becomes faint and prostrated, has pains in the back and legs, and the temperature rises to 102° or 103°. The breathing is rapid, and he complains of much pain in the chest. There may be a cough and signs of bronchitis. So prominent in some instances are these bronchial symptoms that a pulmonary form of the disease has been described. The pulse is feeble and very rapid. There may be vomiting, and death may occur within twenty-four hours with symptoms of profound collapse and prostration. Other cases are more protracted, and there may be diarrhœa, delirium, and unconsciousness. The cerebral symptoms may be most intense; in at least four cases the brain seems to have been chiefly affected, and its capillaries stuffed with bacilli (Merkel). The recognition of wool-sorter's disease as a form of anthrax is due to J. H. Bell, of Bradford.

In certain instances these profound constitutional symptoms of internal anthrax are associated with the external lesions of malignant pustule.

The *rag-picker's disease* has been made the subject of an exhaustive study by Eppinger (Die Hadernkrankheit, Jena, 1894), who has shown that it is a local anthrax of the lungs and pleura, with general infection.

Prophylaxis.—This is important, and should be carried out by a most rigid disinfection of the hides, hair, and rags before they are placed in the hands of the workmen. It is suggested to soak the hides for 24 hours in a solution of 1 per cent. formic acid and 0.02 per cent. of mercuric perchloride. Animals may be immunized against the disease and Pasteur's method of vaccination has been extensively employed in France with good results. The immunity is lost within a year in nearly 50 per cent. of the animals.

Treatment.—In malignant pustule the site of inoculation should be excised and, after the cautery or pure carbolic acid is applied, powdered bichloride of mercury sprinkled over the exposed surface. The local development of the bacilli about the site of inoculation may be prevented by the subcutaneous injections of solutions of carbolic acid (3 per cent.) or bichloride of mercury (1 to 1,000). The injections should be made at various points around the pustule, and may be repeated two or three times a day. The

Kraus & Argentina. normal horse serum 20-30 cc. intravenously or subcut
serum treated horse for 1½ hrs. before.

Marchoux and Ly
The dose is 30 to 40 cc. given subcut. and
5 to 15 cc. given intravenously.

internal treatment should be confined to the administration of stimulants and plenty of nutritious food.

In malignant forms, particularly the intestinal cases, little can be done. Active purgatives may be given at the outset, so as to remove the infecting material. Quinine in large doses has been recommended.

An anti-anthrax serum has been prepared by Sclavo, for which good results are claimed.

XVIII. LEPROSY

Definition.—A chronic infectious disease caused by *Bacillus lepræ*, characterized by the presence of tubercular nodules in the skin and mucous membranes (tubercular leprosy) or by changes in the nerves (anæsthetic leprosy). At first these forms may be separate, but ultimately both are combined, and in the characteristic tubercular form there are disturbances of sensation.

History.—The disease appears to have prevailed in Egypt even so far back as three or four thousand years before Christ. The Hebrew writers make many references to it, but, as is evident from the description in Leviticus, many different forms of skin disease were embraced under the term leprosy. Both in India and in China the affection was also known many centuries before the Christian era. The old Greek and Roman physicians were perfectly familiar with its manifestations. Evidence of a pre-Columbian existence of leprosy in America has been sought in the old pieces of Peruvian pottery representing deformities suggestive of this disease, but Ashmead denies their significance. Throughout the middle ages leprosy prevailed extensively in Europe, and the number of leper asylums has been estimated as at least 20,000. During the sixteenth century it gradually declined.

Geographical Distribution.—In Europe leprosy prevails in Iceland, Norway and Sweden, parts of Russia, particularly about Dorpat, Riga, and the Caucasus, and in certain provinces of Spain and Portugal. In Great Britain the cases are now all imported.

In the United States there were 139 cases in 1909, of which 50 were in Louisiana, 20 in Florida, 16 in Minnesota, and 12 in Texas. In the Dominion of Canada there are foci of leprosy in two or three counties of New Brunswick, settled by French Canadians, and in Cape Breton, Nova Scotia. The disease appears to have been imported from Normandy about the end of the 18th century. The number has gradually lessened, and now only a few cases remain in the lazaretto at Tracadie.

Leprosy is endemic in the West India Islands. It also occurs in Mexico and throughout the Southern States. In the Sandwich Islands it spread rapidly after 1860, and strenuous attempts have been made to stamp it out by segregating all lepers on the island of Molokai. In the Philippine Islands, in a population of over six millions, there are 2,330 lepers.

In British India, according to the Leprosy Commission, there are 100,000 lepers. This is probably a low estimate. In China leprosy prevails extensively. In South Africa it has increased rapidly. In Australia, New Zealand, and the Australasian islands it also prevails, chiefly among the Chinese. The essays of Ashburton Thompson and James Cantlie deal fully with leprosy in China, Australia, and the Pacific islands. In Egypt the census of 1907 gave 6,000 lepers.

Etiology.—*Bacillus lepræ*, discovered by Hansen, of Bergen, in 1871, is universally recognized as the cause of the disease. It has many points of resemblance to the tubercle bacillus, but can be readily differentiated. It has been cultivated, but with difficulty, and is stated to have a pleomorphism of which the bacillus as seen in the tissues is only one phase.

Modes of Infection.—(*a*) *Inoculation.*—While it is highly probable that leprosy may be contracted by accidental inoculation, the experimental evidence is as yet inconclusive. With one possible exception, negative results have followed the attempts to reproduce the disease in man. The Hawaiian convict, under sentence of death, who was inoculated on September 30, 1884, by Arning, four weeks later had rheumatoid pains and gradual painful swelling of the ulnar and median nerves. The neuritis gradually subsided, but there developed a small lepra tubercle at the site of the inoculation. In 1887 the disease was quite manifest, and the man died of it six years after inoculation. The case is not regarded as conclusive, as he had leprous relatives and lived in a leprous country.

(*b*) *Heredity.*—For years it was thought that the disease was transmitted from parent to child, but the general opinion, as expressed in the recent Leprosy Congress in Berlin, was decidedly against this view. Of course, the possibility of its transmission cannot be denied, and in this respect leprosy and tuberculosis occupy very much the same position, though men with very wide experience have never seen a new-born leper. The youngest cases are rarely under three or four years of age.

(*c*) *By Contagion.*—The bacilli are given off from the open sores; they are found in the saliva and expectoration of the cases with leprous lesions in the mouth and throat, and occur in very large numbers in the nasal secretion. Sticker found in 153 lepers, subjects of both forms of the disease, bacilli in the nasal secretion in 128, and herein, he thinks, lies the chief source of danger. Schaffer was able to collect lepra bacilli on clean slides placed on tables and floors near to lepers whom he had caused to read aloud. The bacilli have also been isolated from the urine and the milk of patients. It seems probable that they may enter the body in many ways through the mucous membranes and through the skin. Sticker believes that the initial lesion is in an ulcer above the cartilaginous part of the nasal septum. One of the most striking examples of the contagiousness of leprosy is the following: "In 1860, a girl who had hitherto lived at Holstfershof, where no leprosy existed, married and went to live at Tarwast with her mother-in-law, who was a leper. She remained healthy, but her three children (1, 2, 3) became leprous, as also her younger sister (4), who came on a visit to Tarwast and slept with the children. The younger sister developed leprosy after returning to Holstfershof. At the latter place a man (5), fifty-two years old, who married one of the 'younger sister's' children, acquired leprosy; also a relative (6), thirty-six years old, a tailor by occupation, who frequented the house, and his wife (7), who came from a place where no leprosy existed. The two men last mentioned are at present (1897) inmates of the leper asylum at Dorpat." There is certain evidence to show that the disease may be spread through infected clothing, and the high percentage of washerwomen among lepers is also suggestive.

Conditions Influencing Infection.—The disease attacks persons of all

Hyperbolic of nichts common.

ages. We do not yet understand all the conditions necessary. Evidently the closest and most intimate contact is essential. The doctors, nurses, and Sisters of Charity who care for the patients are very rarely attacked. In the lazaretto at Tracadie not one of the Sisters who for more than fifty years have so faithfully nursed the lepers has contracted the disease. Father Damian, in the Sandwich Islands, and Father Boblioli, in New Orleans, both fell victims in the discharge of their priestly duties. There has long been an idea that possibly the disease may be associated with some special kind of food, and Jonathan Hutchinson believes that a fish diet is the *tertium quid*, which either renders the patient susceptible or with which the poison may be taken.

Morbid Anatomy.—The leprosy tubercles consist of granulomatous tissue made up of cells of various sizes in a connective-tissue matrix. The bacilli in extraordinary numbers lie partly between and partly in the cells. The process gradually involves the skin, giving rise to tuberous outgrowths with intervening areas of ulceration or cicatrization, which in the face may gradually produce the so-called *facies leontina*. The mucous membranes, particularly the conjunctiva, the cornea, and the larynx, may gradually be involved. In many cases deep ulcers form which result in extensive loss of substance or loss of fingers or toes, the so-called *lepra mutilans*. In anæsthetic leprosy there is a peripheral neuritis due to the development of the bacilli in the nerve-fibres. Indeed, this involvement of the nerves plays a primary part in the etiology of many of the important features, particularly the trophic changes in the skin and the disturbances of sensation.

Clinical Forms.—(*a*) Tubercular Leprosy.—Prior to the appearance of the nodules there are areas of cutaneous erythema which may be sharply defined and often hyperæsthetic. This is sometimes known as *macular* leprosy. The affected spots in time become pigmented. In some instances this superficial change continues without the development of nodules, the areas become anæsthetic, the pigment gradually disappears, and the skin gets perfectly white—the *lepra alba*. Among the patients at Tracadie it was particularly interesting to see three or four in this early stage presenting on the face and forearms a patchy erythema with slight swelling of the skin. The diagnosis of the condition is perfectly clear, though it may be a long time before any other than sensory changes develop. The eyelashes and eyebrows and the hairs on the face fall out. The mucous membranes finally become involved, particularly of the mouth, throat, and larynx; the voice becomes harsh and finally aphonic. Death results not infrequently from the laryngeal complications and aspiration pneumonia. The conjunctivæ are frequently attacked, and the sight is lost by a leprous keratitis.

(*b*) Anæsthetic Leprosy.—This remarkable form has, in characteristic cases, no external resemblance whatever to the other variety. It usually begins with pains in the limbs and areas of hyperæsthesia or of numbness. Very early there may be trophic changes, seen in the formation of small bullæ (Hillis). Maculæ appear upon the trunk and extremities, and after persisting for a variable time gradually disappear, leaving areas of anæsthesia, but the loss of sensation may come on independently of the outbreak of maculæ. The nerve-trunks, where superficial, may be felt to be large and nodular. The trophic disturbances are usually marked. Pemphigus-like bullæ develop in

the affected areas, which break and leave ulcers which may be very destructive. The fingers and toes are liable to contractures and to necrosis, so that in chronic cases the phalanges are lost. The course of anæsthetic leprosy is extraordinarily chronic and may persist for years without leading to much deformity. I knew a prominent clergyman who had anæsthetic leprosy for more than thirty years, which did not seriously interfere with his usefulness, and not in the slightest with his career.

Diagnosis.—Even in the early stage the dusky erythematous maculæ with hyperæsthesia or areas of anæsthesia are very characteristic. In an advanced grade neither the tubercular nor anæsthetic forms could possibly be mistaken for any other affection. In a doubtful case the microscopic examination of an excised nodule is decisive.

Treatment.—Vaccines have been prepared and good results are claimed by various observers. The Finsen light, X-rays, and radium do good to the local lesions. Nastin, a fatty principle extracted from cultures of a lepra-streptothrix combined with benzoyl chloride, has come into vogue and the Calcutta report is favorable. The gurjun and chaulmoogra oils have been recommended, the former in doses of from 5 to 10 minims, the latter in 2-drachm doses, but their use must be continued for at least two years. Calmette's antivenene, 20 to 30 c. c., subcutaneously, has been followed by remarkable results in a few cases. Segregation should be compulsory in all cases except where the friends can show that they have ample provision in their own home for the complete isolation and proper care of the patient.

XIX. TUBERCULOSIS

I. GENERAL ETIOLOGY AND MORBID ANATOMY

Definition.—An infection caused by *Bacillus tuberculosis*, the lesions of which are characterized by nodular bodies, tubercles, and diffuse infiltrations, which either undergo caseation, necrosis, and ulceration, or heal with sclerosis and calcification.

The very varied clinical features depend upon the organ involved, the intensity of the infection, and the degree of resistance offered by the body.

History.—The Greek physicians made many observations upon the clinical features of pulmonary tuberculosis, and our description of the symptoms and of the consumptive "type" dates from Hippocrates. Galen recognized its contagious nature. In the 17th century F. Sylvius indicated the connection between the tuberculous nodule and phthisis, and Richard Morton, a friend and contemporary of Sydenham, wrote (1689) the first modern treatise on the subject, in which the clinical side of the disease was well considered. He regarded it as contagious. Pierre Desault, William Stark, and Matthew Baillie laid the foundation of our knowledge of the coarse characters of tubercle as the anatomical basis ~~of consumption~~. Our real knowledge of the disease is a 19th century contribution, beginning with the work of Bayle on the structure of the tubercle and on its identity in the widely distributed lesions. With the Traité d'Auscultation Médiate (1819) Laennec laid the foundation not only of our modern knowledge of tuberculosis, but of modern

Rogers. B. M. J. 1916. ii. 550

Iodized unsaturated glycocardiolic acid

= Soluble soaps of [illegible] fatty acids

Chaulmoogra oil – sodium salts of these fatty acids,

2% soln. in saline. + 0.5% carbolic.

Gr 1/10 – Gm 0.

Heiser – Chaulmoogra oil 60 cc. | chlorinized unsaturated.
compounded with 60 cc. | 100 cm. each week = grad. inc. to
mercuric – 4 gm. | 300 cc. each week

J.A.M.A. 1917. June 30

tuberculosis.

Victor
1880. 326 for 10.00
1913. 147.6 " "

1915. 54296.
45

In 1915. tuberculosis 9.79 deaths to the
1515 [illegible]

clinical medicine. This work (easily to be had also in an English translation) should be read from cover to cover by every young doctor, and, when possible, by every senior student. The unity of the forms of the tubercle—the miliary granule, the infiltration, and the caseous mass—was recognized, and for the first time physical signs and anatomical features were correlated, and the course of the disease carefully studied. Virchow led a battle against the unity of tuberculous lesions, and held that the products of any simple inflammation might become caseous, and that the ordinary so-called catarrhal pneumonia might terminate in phthisis.

The contagiousness of the disease, a belief in which had all along been held by individuals, and was widely spread in certain countries—as in Italy—was emphasized and confirmed by the brilliant work of Villemin, who first placed the infective nature of the disease on a solid experimental basis. There is nothing more masterly in the literature of experimental medicine than his work. Then came the demonstration by Robert Koch (in 1882) of the *Bacillus tuberculosis*. The preliminary article in the Berliner klin. Wochenschrift (1882) and the more complete work (Mitteilungen a. d. k. Gesundheitsamte, Bd. 2) should be studied by all who wish to appreciate the value of scientific methods. The thoroughness of Koch's work is manifested by the fact that, in the years that have elapsed, the innumerable workers have amplified and extended, but in no way essentially modified his original position.

During the past thirty years we have been gradually getting accommodated to the new views, the most important single effect of which has been a world-wide crusade against tuberculosis as a preventable disease.

Distribution.—The disease is widely spread zoologically.

(*a*) In Animals.—Of animals the cold-blooded are rarely affected. In birds the disease is not uncommon, particularly in fowls, but there are minor differences between the avian and mammalian forms. In the domestic animals tuberculosis is a common disease, particularly in cattle. In sheep, goats, and horses it is rare. In pigs it is not uncommon in certain parts of Europe. Cats and dogs are not prone to the disease. In monkeys in confinement it is very common. The most important single fact in the distribution of the disease in animals is its widespread prevalence in bovines, from which nearly all the milk and a large proportion of our meat are derived.

(*b*) In Man.—Tuberculosis is his most universal scourge, well deserving the epithet bestowed upon it by Bunyan of the "Captain of the Men of Death." It is estimated that at least one-seventh of all deaths are due to it. In England and Wales there were 54.435 deaths from tuberculosis in 1909. In the United States it is estimated that it is responsible for about one-ninth of the deaths annually. There has been a remarkable reduction in England in the death-rate within the past forty years, as shown by the following figures:

1871-1880	rate	per	100,000	of	population,	219
1881-1890	"	"	"	"	"	178
1891-1900	"	"	"	"	"	139
1901-1910	"	"	"	"	"	117

It has dropped nearly 50 per cent. in 40 years.

In London the death-rate from consumption has declined 33 per cent. between 1901 and 1910, and other forms of tuberculosis show a similar fall.

In 1909, 54,435 deaths from tuberculosis occurred, 38,639 of which were from pulmonary consumption. Had the death-rate been as high as during an average year of the 1871-1880 period the number of deaths from phthisis would have been 78,308, instead of 38,639 (Newsholme). The mortality has been cut in half! To a less striking degree, but practically everywhere in the civilized world, there has been a reduction in the death-rate—the most encouraging feature of modern sanitation. To what is this to be attributed? *First.* To the improved social condition of the people, better housing, better food, better habits. The falling death-rate began before the present campaign against the disease. *Secondly.* The education of the people, which has made great strides, and a larger proportion are striving to lead hygienic lives. There are less drunkenness, less overcrowding, better air, and better food. The habit of spitting in public has been checked, and we may say confidently that the seeds of the disease are not spread so broadcast. *Thirdly.* As Newsholme points out, segregation has done much to protect the healthy from the sick. In the year 1910, 20.5 per cent. of the deaths in England and Wales and 43.4 per cent. of the deaths in London occurred in public institutions for the sick. In America, in Germany, and in France this factor also holds good. *Fourthly.* The cases are seen earlier and the condition is recognized before it is hopeless. Unquestionably in a larger number of persons with pulmonary disease the diagnosis is made at a stage when complete healing is possible. The two important elements then are, fewer seeds, more stony soil. The economic loss from tuberculosis has been estimated by various writers. Baldwin puts it for the United States at from 150 to 200 millions of dollars annually.

Etiology: the Bacillus tuberculosis.—(*a*) The Seed.—The *Bacillus tuberculosis* is a minute rod-shaped organism slightly bent or curved, with an average length of from 3 to 4 μ. When stained it may present a beaded appearance; whether due to spores or vacuoles is doubtful. Aberrant forms are not uncommon, i. e., long filaments or branched forms. It stains in a characteristic way with aniline dyes, and in cultures the mode of growth is very distinctive.

Specific varieties are recognized. As already stated, the avian form has well-marked peculiarities, but the great point of discussion has been the relation of the bacillus causing human to that which causes bovine tuberculosis. Differences in the character of the tubercles of these two classes had long been recognized, and Theobald Smith pointed out special differences between the human and the bovine bacilli. But the matter was brought to a focus in 1901 by Koch's statement that the bacilli of bovine tuberculosis did not cause human tuberculosis, and *vice versa.* The question has now been submitted to the test by a number of commissions, and it is generally recognized that there are differences between the two forms. The recent report of the English commission confirms the view that the bovine organism is capable of producing the disease in man, in whom it may often be recognized as a special form.

The virulence of the individual strains varies, a factor of great importance in all specific infections.

In the Body.—The bacilli are found in all tuberculous lesions, particularly in those actively growing, but in the chronic disease of the lymph glands and of the joints they are scanty. In all caseous foci they are few in number,

? radio cutting off this record - see here more to say

In the sputum in pulmonary tuberculosis they may be present in countless myriads. They are found in the blood, particularly in cases of miliary tuberculosis.

Outside the Body.—The tubercle bacilli are widely scattered and are found in varying numbers wherever human beings are crowded together. There are two chief sources—the expectoration of persons with advanced disease of the lungs and the milk of tuberculous cows.

From a patient in my wards at the Johns Hopkins Hospital, with moderately advanced disease, Nuttall estimated that from 1½ to 4 1-3 billions of bacilli were thrown off each twenty-four hours. Allowed to dry, the sputum becomes dust and is distributed far and wide. Scores of experiments have shown the presence of the bacilli in dust samples from hospital wards, from public buildings, streets, railway carriages, and various localities. So widely spread are the bacilli that in cities at least few individuals pass a week without affording opportunity for their lodgment, usually in the throat or air passages, inhaled with dust. They may readily contaminate food. The hands of tuberculous subjects are almost always contaminated. From the street, tuberculous sputum may be brought into the house on shoes, on the long skirts of women, on the hair of dogs, etc. It is interesting to note that in some of the places most frequented by tuberculous subjects, e. g., the sanatoria, the dust (as shown by experiments at Saranac) may be free from bacilli.

Bovine bacilli are distributed by means of the milk, rarely by the flesh, and still more rarely by contact with the animals. A proportion of all cases of infection in childhood are with this variety. A careful study by Park and Krumwiede showed that bovine tuberculosis is practically negligible in adults but in young children it causes from 6 to 10 per cent. of the deaths from tuberculosis.

So widely spread everywhere is the seed, that the soil, the conditions suitable for its growth, is practically of equal moment.

(*b*) The Soil.—Many years ago I drew the parallel between infection in tuberculosis and the parable of the sower, which though now somewhat hackneyed illustrates in an effective way the importance of the nature of the ground upon which the seed falls. *"Some seeds fell by the wayside and the fowls of the air came and devoured them up."* These are the bacilli scattered broadcast outside the body, an immense majority of which die. *"Some fell upon stony places."* These are the bacilli that find lodgment in many of us, perhaps, with the production of a small focus, but nothing comes of it; they wither away "because they have no root." *"Some fell among thorns, and the thorns sprang up and choked them."* This represents the cases of tuberculosis, latent or active, in which the seed finds the soil suitable and grows, but the conditions are not favorable, as the thorns, representing the protecting force of the body, get the better in the struggle. *"But others fell on good ground and sprang up and bare fruit an hundredfold."* Of this fourth group were the 54,435 who died of the disease in 1909 in England—the soil suitable, the protecting forces feeble.

What makes a good soil? Fortunately the human body is not a very good culture medium for the tubercle bacillus. The adult human individual in normal health seems to be practically immune to natural infection (Baldwin). And yet one-seventh of the human race dies of tuberculosis, but a large pro-

portion of all individuals become infected before reaching adult life and never have the disease. The studies of Naegli, Burkhardt, and others show that in fully 90 per cent. of the bodies of city-dwellers who have died of disease other than tuberculosis small tuberculous lesions are present. This is probably too high an estimate for England or the United States. Franz has shown that over 60 per cent. of healthy young adults react to the subcutaneous tuberculin test. Using more delicate tuberculin tests it is found that nearly all adults react, and according to Hamburger, who has employed the subcutaneous-local reaction, over 90 per cent. of children are infected before reaching the twelfth year of life. This means, of course, that in a very small proportion of those upon whom the seed falls is the soil suitable for active growth—only a natural immunity keeps the race alive.

What this suitable soil is has been the subject of much discussion. From the time of Hippocrates the profession has recognized a tuberculous habitus, which has been variously described as disposition, diathesis, dyscrasia, temperament, constitution, or by the German word "Anlage." These terms are not always regarded as interchangeable, but here for practical purposes Ribbert's definition suffices, that a disposition is "that peculiarity in the organism which allows of the effective working of the exciting causes of a disease." Manifestly, such a disposition or constitution of the body may be inherited or acquired. The studies of Pearson indicate the very great importance of heredity in the phthisical soil. He concludes that "the diathesis of pulmonary tuberculosis is certainly inherited, and the intensity of the inheritance is sensibly the same as that of any normal physical character yet investigated in man. Infection probably plays a necessary part, but in the artisan classes of the urban populations of this country (England) it is doubtful if their members can escape the risks of infection, except by the absence of diathesis—i. e., the inheritance of what amounts to a counter-disposition."

Hippocrates defines the *habitus phthisicus* in the following words: "The form of body peculiar to subjects of phthisical complaints was the smooth, the whitish, that resembled the lentil; the reddish, the blue-eyed, the leucophlegmatic, and that with the scapulæ having the appearance of wings." The so-called scrofulous type has broad coarse features, opaque skin, large thick bones, and heavy figure.

Acquired disposition may arise through a lowering of the resistance of the body forces. Dwellers in cities in the dark, close alleys, and tenement houses, workers in cellars and ill-ventilated rooms, persons addicted to drink, are much more prone to the disease. The influence of environment was never better demonstrated than in the well-known experiment of Trudeau, who found that rabbits inoculated with tuberculosis if confined in a dark, damp place, without sunlight and fresh air, rapidly succumbed, while others treated in the same way, but allowed to run wild, either recovered or showed very slight lesions. The occupants of prisons, asylums, and poorhouses, too often, indeed, in barracks and large workshops, are in the position of Trudeau's rabbits in the cellar, and under the conditions most favorable to foster the development of the bacilli which may have lodged in their tissues.

No age is exempt. The disease is met with in the suckling and in the octogenarian, but fatal tuberculosis is, as Hippocrates pointed out, more common between the eighteenth and thirty-fifth year. The influence of sex is

Add Subcontractor

very slight. On the other hand the influence of race is important. It is a very fatal disease in the negroes, particularly in the southern United States, and in the North American Indians. The Irish, both at home and in the United States, are more prone to the disease than other European races. The Jews everywhere have a low mortality from tuberculosis.

Occupation has an influence, in so far as insanitary surroundings, exposure to dust, close confinement, long, irregular hours, and low rates of wages, favor the prevalence of the disease. Certain local conditions influence the soil very greatly. Catarrh of the respiratory passages appears to lower the resistance and favor the conditions which enable the bacilli to enter the system, or to grow in the tissues. The specific fevers, particularly measles and whooping-cough, predispose to tuberculosis; and any lowering disease may do so, but in such cases it is very often not a fresh infection, but the blazing of a smouldering fire. ~~As is well known,~~ The soil of diabetes is ~~very~~ favorable to the growth of the tubercle bacilli. Many chronic affections lower the resistance and ~~make the soil more favorable.~~ It is notorious in hospital practice how often the fatal event in arterio-sclerosis, cirrhosis of the liver, etc., is a terminal acute tuberculosis.

Trauma, as for example a blow on the chest, injury to the knee, a blow upon the head, may be followed by local tuberculosis. The injured part for a time is a *locus minoris resistentiæ*, and the bacilli already present grow in the favorable conditions caused by the injury.

(*c*) Specific Reactions of the Bacilli.—In its growth the bacillus so far as we know does not form soluble toxins, at least not in the cultures. It causes (1) a local tissue reaction which results in the formation of a new growth, the tubercle; (2) changes in the metabolism of the body fluids. The local tissue reactions will be considered later; here we may speak of the phenomena grouped under the term immunity.

(1) *Tuberculin Reaction.*—An animal inoculated subcutaneously with tubercle bacilli, or with dead cultures, has a local reaction associated with the formation of a tubercle; the neighboring lymph glands become involved, and in susceptible animals the disease generalizes and causes death. Koch found that if to a guinea-pig with a subcutaneous focus of tuberculosis so caused a second injection of the bacillus was given, healing occurred in the primary nodule, and the animal did not die. Upon these facts his ~~famous~~ tuberculin treatment was based. Tuberculin consists of the dead and macerated bacilli together with any substances formed in the cultures. If into a healthy person .25 c. c. of tuberculin is injected, there is a very slight fever with a little feeling of uneasiness which passes off in from twelve to twenty-four hours. If into an individual with a focus of tuberculosis doses of .015 c. c. of tuberculin are injected subcutaneously, there is an active local reaction about the tuberculous focus, with intense inflammation leading often to necrosis and, in the case of a skin tubercle, as lupus, in which the process can be followed, healing is seen to take place. This process, now known as the "tuberculin reaction," is used extensively for purposes of diagnosis. The chief methods in use are the ophthalmo-reaction of Calmette and the cutaneous of von Pirquet. ~~For the Calmette reaction Koch's old tuberculin is used, prepared in a special way.~~ A drop of the solution, placed on the conjunctiva of a person with a focus of tuberculosis anywhere in the system, is followed in a

few hours by a deep injection of the blood-vessels, increased lachrymation, and a slight swelling of the membrane. This, known as a positive reaction, lasts for from twenty-four to thirty-six hours.

For the skin reaction of von Pirquet a couple of drops of tuberculin are placed on a disinfected region of the skin, and the epidermis is scarified through the drops without drawing blood. If positive, at the end of twenty-four hours there is an inflammatory reaction which reaches its maximum in from thirty-six to forty-eight hours. For clinical purposes the tuberculin reaction is to be relied on, but that it may be given by a small focus of latent disease in a healthy person and that it has been found to be positive in as large a proportion as 60 per cent. of apparently normal individuals are facts which diminish its practical value.

(2) *Immunity Changes.*—In an infected person certain changes occur in the blood serum, depending upon the development of so-called antibodies, the presence of which may be demonstrated by the method of complement fixation; and the serum also contains agglutinins which possess an agglutinating action on the tubercle bacilli. Either directly themselves or through the toxic products there are brought into play certain cellular and humoral reactions which are capable of destroying the infecting agents or of neutralizing their effects or of limiting their activities. There exist in the blood-serum antibodies, called by Wright opsonins, which have the power of stimulating phagocytosis. When these opsonins are abnormally low, the bacilli that gain entrance to the body can multiply at the point of infection. This increase is associated with a still further local reduction in the opsonins. Wright believes that the amount of opsonin in the serum is an indication of the defensive capacity of the individual, and he has established what he calls an "opsonic index," which is the ratio between the number of bacteria found within twenty to forty polymorpho-leucocytes in an emulsion made with the patient's serum and the number of bacteria found in the same number of similar leucocytes in an emulsion made with a normal serum, the latter being taken as 1.0. This index in tuberculous patients is usually low, varying from .1 to .8. When tuberculin is injected, the production of opsonins is stimulated, and the opsonic index rises. With the body fluids richer in opsonins than before, the phagocytes are more active and more bacilli are destroyed. Experimentally in animals, according to the virulence of the organism and the dose, all gradations of symptoms may be produced, from the slightest local reaction to the profoundest septicæmia with high fever and death. In a local tuberculous infection, such as happens to the great majority of us in some part of our bodies at some time in our lives, happily the protective mechanism suffices to localize and limit the invaders. It may amount only to a skirmish, such as is constantly going on at the frontiers of a great empire, but if the local infection is more virulent, or becomes wider spread, the products of the growth of the bacilli or the bacilli themselves enter the circulation, ~~occasioning what is called~~ an auto-inoculation, in which case the general metabolism is disturbed, fever is produced, and antibodies are formed to counteract the infective products. The rationale of the use of tuberculin is to stimulate the fighting forces of the body—to mobilize them, so to speak—in the fight that is going on in an infected area. The whole question of active immunization in tuberculosis is being thoroughly studied, and, while many have thrown doubt on

the trustworthiness and the usefulness of the opsonic index as a gauge of the progress of a case, there can be no question that Wright's researches have put us in the right path for a scientific treatment of the disease.

Recent studies on anaphylaxis or hypersensitiveness to foreign proteins have an important bearing on the question of immunity in tuberculosis. Baldwin of Saranac Lake, in a series of experiments, has demonstrated that sensitization to and subsequent intoxication by tubercle bacillus protein follow the general laws of anaphylaxis established for the parenteral introduction of horse serum. From his experiments we may now reasonably interpret the tuberculin reaction as an anaphylactic phenomenon. Undoubtedly hypersensitiveness to the tubercle bacillus protein is directly responsible for the so-called toxic symptoms of tuberculous disease. Koch in his original experiments that led up to the introduction of tuberculin observed a marked difference in the reaction of healthy and tuberculous animals to cutaneous inoculation with tubercle bacilli. In healthy animals the wound closes and for a few days seems to heal, but in from ten to fourteen days a hard nodule appears, which soon breaks down. General infection occurs and the ulcer remains open to the time of the death of the animal. In tuberculous animals extensive ulceration occurs on the second or third day after vaccination, but the ulcer heals quickly and permanently, without even the neighboring lymph glands becoming infected. Roemer has extended Koch's observations and has demonstrated that tuberculous animals may react in one of three ways to injections of tubercle bacilli: (1) If a small dose be given, a dose, however, surely fatal for healthy animals, infection does not occur. The animals are therefore highly resistant to re-infection. (2) If a large dose be given, the animals die promptly, with the symptoms of an intense intoxication. The condition is analogous to the anaphylactic shock. (3) If a moderate dose be given, the animals display the symptoms of a profound intoxication, but gradually recover, and, although infection follows, a mild and chronic form of the disease is produced. Upon the same principle depends the protective inoculation of calves, so successfully practiced by v. Behring and Koch. The animals receive injections of human tubercle bacilli and, although anatomically disease does not follow their introduction, the calves become highly sensitive to tuberculin and at the same time immune to doses of bovine tubercle bacilli fatal to unprotected calves. At the end of a year the tuberculin hypersensitiveness disappears, and the calves again become susceptible to infection. While we are not in a position to state that protection depends upon the same mechanism that produces hypersensitiveness to the tubercle bacillus protein, the two phenomena are undoubtedly closely related.

Antituberculous serums have been obtained from animals immunized by the tubercle bacillus or its products. The two most important are those of Marmorek and of Maragliano.

(*d*) Modes of Infection.—(1) *Hereditary Transmission.*—In order that the disease could be transmitted by the sperm it would be necessary that the tubercle bacilli should lodge in the individual spermatozoön which fecundates an ovum. The chances that such a thing could occur are extremely small, looking at the subject from a numerical point of view, although we know that bacilli do occasionally exist in the semen; they become still smaller when we consider that the spermatozoön is made up of nuclear material, which the

tubercle bacillus is never known to attack. The possibility of transmission by the ovum must be accepted. Baumgarten has in one instance been able to detect the tubercle bacillus in the ovum of a female rabbit which he had artificially fecundated with tuberculous semen.

The almost constant method of transmission in congenital tuberculosis is through the blood current, the tubercle bacilli penetrating by way of the placenta. In these cases the placenta itself is usually the seat of tuberculosis; but there are undoubted instances in which, with an apparently sound placenta, both the placental blood and the fetal organs contained tubercle bacilli, notwithstanding the fact that the organs also appeared normal. The number of cases of congenital tuberculosis in man is very small; it is more common in cattle.

Possible Latency of the Tubercle Germs.—Baumgarten and his followers assume that the tubercle bacilli lie latent in the tissues and subsequently develop when, for some reason or other, the individual resistance is lowered. He likens such cases of latent tuberculosis to the late hereditary forms of syphilis, and explains the lack of development of the germs by the greater resisting power of the tissues of children. Baumgarten bases his belief in germ transmission upon two main factors—the great frequency of the disease in early life and the localization of tuberculous lesions in children.

Against this theory are the facts that the percentage of cases of congenital tuberculosis is extremely small, and that in the great majority of instances the organs of fetuses born of tuberculous mothers give negative results when inoculated into guinea-pigs.

(2) *Inoculation.—Cutaneous.*—The infective nature of tuberculosis was first demonstrated by Villemin, who showed in 1865 that it could be transmitted to animals by inoculation. The experiments of Cohnheim and Salomonsen, who produced tuberculosis in the eyes of guinea-pigs and rabbits by inoculating fresh tubercle into the anterior chamber, confirmed and extended Villemin's original observations and paved the way for the reception of Koch's announcement. This mode of infection is seen in persons whose occupation brings them in contact with the dead bodies or animal products. Demonstrators of morbid anatomy, butchers, and handlers of hides are subject to a local tubercle of the skin, which forms a reddened mass of granulation tissue, usually capping the dorsal surface of the hand or a finger. This is the so-called post mortem wart, the *verruca necrogenica* of Wilks. The demonstration of its nature is shown by the presence of tubercle bacilli, and by inoculation experiments in animals.

In the performance of the rite of circumcision children have been accidentally inoculated. Infection in these cases is probably always associated with disease in the operator, and occurs in connection with the habit of cleansing the wound by suction.

Other means of inoculation have been described: as the wearing of earrings, washing the clothes of phthisical patients, the bite of a tuberculous subject, or inoculation from a cut by a broken spit-glass of a consumptive; and Czerny has reported two cases of infection by transplantation of skin.

It has been urged by the opponents of vaccination that tuberculosis, as well as syphilis, may be thus conveyed, but of this there is no evidence. Lymph of revaccinated consumptives is non-infective. Lupus has originated

at the site of vaccination in a few cases (C. Fox, Graham Little). It may be said, on the whole, that inoculation in man plays a trifling rôle in the transmission of tuberculosis.

Mucous membrane inoculation is probably important in childhood through abrasions of the lips, tongue or gums, though a primary focus is not often seen. The open door in the mouth and throat is more often by loss of the protective epithelium due to catarrhal and ulcerative processes.

(3) *Infection by Inhalation.*—A belief in the contagiousness of pulmonary tuberculosis originated with the early Greek physicians, and has persisted among the Latin races. The investigations of Cornet afford conclusive proof that the dust of a room or other locality frequented by patients with pulmonary tuberculosis is infective. The bacilli attached to fine particles of dust are inhaled and gain entrance to the system through the lungs.

Flügge denies that the bacillus-containing dust is the dangerous element in infection. Experimentally he has only succeeded in producing the disease when there is some lesion in the respiratory tract. He thinks that the danger of infection by the dry sputum is very improbable. On the other hand, he thinks that the infection is chiefly conveyed by the free, finely divided particles of sputum produced in the act of coughing, and that these tiny fragments are suspended in the atmosphere. Those who cough very much and with the mouth open are most liable to infect the surrounding air.

It is well remarked by Cornet, "The consumptive in himself is almost harmless, and only becomes harmful through bad habits." It has been fully shown that the expired air of consumptives is not infective. The virus is only contained in the sputum, which when dry is widely disseminated in the form of dust, and constitutes the great medium for the transmission of the disease.

Among the points urged in favor of the inhalation view are:

(*i*) Primary tuberculous lesions are in a majority of all cases connected with the respiratory system. The frequency with which foci are met with in the lungs and in the bronchial glands is extraordinary, and the statistics of the Paris morgue show that a considerable proportion of all persons dying of accident or by suicide present evidences of the disease in these parts. The post mortem statistics of hospitals show the same widespread prevalence of infection through the air passages. Biggs reports that more than 60 per cent. of his post mortems showed lesions of pulmonary tuberculosis. In 125 autopsies at the Foundling Hospital, New York, the bronchial glands were tuberculous in every case. In adults the bronchial glands may be infected and the individual remain in good health.

(*ii*) The greater prevalence of tuberculosis in institutions in which the residents are confined and restricted in the matter of fresh air and a free open life—conditions which would favor, on the one hand, the presence of the bacilli in the atmosphere, and, on the other, lower the vital resistance of the individual. The investigations of Cornet upon the death-rate from consumption among certain religious orders devoted to nursing give some striking facts in illustration of this. In a review of 38 cloisters, embracing the average number of 4,028 residents, among 2,099 deaths in the course of twenty-five years, 1,320 (62.88 per cent.) were from tuberculosis. In some cloisters more than three-fourths of the deaths are from this disease, and the mortality

in all the residents, up to the fortieth year, is greatly above the average, the increase being due entirely to the prevalence of tuberculosis. It has been stated that nurses are not more prone to the disease than other individuals, but Cornet says that, of 100 nurses deceased, 63 died of tuberculosis. The more perfect the prophylaxis and hygienic arrangements of an asylum or institution, the lower the death-rate from tuberculosis. The mortality in prisons has been shown by Baer to be four times as great as outside. The death-rate from ~~phthisis~~ is estimated at 15 per cent. of the total mortality, while in prisons it constitutes from 40 to 50 per cent., and in some countries, as Austria, over 60 per cent. Flick ~~has~~ studied the distribution of the deaths from tuberculosis in a single city ward in Philadelphia for twenty-five years. His researches go far to show that it is a house disease. About 33 per cent. of infected houses have had more than one case. There are, however, opposing facts. The statistics of the Brompton Consumption Hospital show that doctors, nurses, and attendants are rarely attacked. Dettweiler claims that no case of tuberculosis has been contracted among his nurses or attendants at Falkenstein. Among 174 previously healthy sanitarium physicians whose average term of service was three years only two became tuberculous (Sangmann). On the other hand, in the Paris hospitals tuberculosis decimates the attendants.

(*iii*) Special danger is believed to exist when the contact is very intimate, as between man and wife. Until recently nearly all writers have held that under these circumstances the husband or wife is much more likely subsequently to die of tuberculosis. Upon the figures of the late Ernest Pope, of Saranac, Karl Pearson bases the following conclusions: (*a*) There is some sensible but slight infection between married couples; (*b*) this is largely obscured or forestalled by the fact of infection from outside sources; (*c*) the liability to the infection depends on the presence of the necessary diathesis; (*d*) assortative mating probably accounts for at least two-thirds, and infective action not more than one-third of the whole correlation observed in these cases. There are cases in which this source of infection seems to play an important rôle.

(4) *Infection by Ingestion.*—~~The work of the past few years has shown that~~ There are two other channels, the tonsils and the intestines, both of great importance.

(*i*) *Tonsillar Infection.*—The frequency of involvement of these glands has been shown by Schlenker, Arthur Latham, and Walsham. The bacilli pass to the glands of the neck and of the mediastinum, and reach the circulation through the lymph-channels. Or an infected bronchial gland becomes adherent to a branch of the pulmonary artery; if a large number of bacilli escape, miliary tuberculosis follows; if only a small number, they reach the lungs, at the apices of which they find conditions suitable for their growth. Through this tonsillar-cervical route bacilli may gain entrance without causing local disease at the portal of entry. It is a common method of infection in children, causing the "scrofulous" glands of the neck.

(*ii*) *Intestinal Infection.*—Behring announced in 1903 that pulmonary tuberculosis could be induced through intestinal infection, and he further maintained that milk fed to infants was the chief cause of consumption in adults, the infection remaining latent. Behring's first contention was sup-

ported by Ravenel and others, who produced pulmonary tuberculosis in animals by feeding experiments, and it was demonstrated that the intestinal surface itself might remain intact. This does away with the objection raised by Koch that, if infection through the milk of tuberculous cattle were common, primary intestinal tuberculosis should be more frequent, whereas in ten years among 3,104 cases of tuberculosis in children there were only 16 of primary bowel infection. Recent experiments have shown in a striking manner how the lungs act as filters for particles absorbed from the intestines. Vansteenberghe and Grysez have produced anthracosis of the lungs by introducing china-ink emulsion directly into the stomach (see Anthracosis). They found a remarkable difference in young and adult guinea-pigs; in the former the carbon particles were filtered out by the mesenteric glands, while the lungs remained free; in the latter the glands were unaffected, but the lungs were carbonized. Calmette and Guérin, repeating the experiments of Ravenel with improved technique, have shown how easily the lungs may be infected through the intestinal route without leaving the slightest trace of disease of the bowel itself. Behring's view of the importance of infection through the intestinal route has thus received the strongest support, and many go so far as to maintain that a majority of all cases of ~~phthisis~~ originate in this manner. The truth is that this ubiquitous bacillus is not particular, and gains entrance through either portal, preferring the throat and intestines in childhood, the bronchi and lungs in adults. The important matter for the individual is the nature of the soil on which it falls.

Milk alone is a common source of intestinal infection, particularly in the large cities. In New York, Hess found tubercle bacilli in 16 per cent. of 107 specimens! The ordinary commercial pasteurization does not kill them. ~~The flesh of tuberculous animals is rarely dangerous.~~

General Morbid Anatomy and Histology of Tuberculous Lesions.—(*a*) Distribution of the Tubercles in the Body.—The organs of the body are variously affected by tuberculosis. In adults, the lungs may be regarded as the seat of election; in children, the lymph-glands, bones, and joints. In 1,000 autopsies there were 275 cases with tuberculous lesions. With but two or three exceptions the lungs were affected. The distribution in the other organs was as follows: Pericardium, 7; peritoneum, 36; brain, 31; spleen, 23; liver, 12; kidneys, 32; intestines, 65; heart, 4; and generative organs, 8.

Among 8,873 surgical patients at the Würzburg clinic, 1,287 were tuberculous, with the following distribution of lesions: Bones and joints, 1,037; lymph-glands, 196; skin and connective tissues, 77; mucous membranes, 10; genito-urinary organs, 20.

(*b*) The Changes Produced by the Tubercle Bacilli.—*The Nodular Tubercle.*—A "tubercle" *presents in its early formation nothing distinctive or peculiar, either in its components or in their arrangement.* Identical structures are produced by other parasites, such as the actinomyces, and by the strongylus in the lungs of sheep.

The following changes occur in the evolution of a tubercle:

(1) The tubercle bacilli multiply and disseminate in the surrounding tissues, partly by growth, partly in the lymph currents.

(2) The fixed cells, especially those of connective tissue and the endothelium of the capillaries, multiply and form rounded, cuboidal, or polygonal

bodies with vesicular nuclei—the *epithelioid cells*—inside some of which the bacilli are soon seen.

(3) Leucocytes, chiefly polynuclear, migrate in numbers and accumulate about the focus of infection. They do not survive. Many undergo rapid destruction. Later, as the little tubercle grows, the leucocytes are chiefly of the mononuclear variety (lymphocytes), which do not undergo the rapid degeneration of the polynuclear forms.

(4) A retriculum of fibres is formed by the fibrillation and rarefaction of the connective-tissue matrix. This is most apparent, as a rule, at the margin of the growth.

(5) In some, but not all, tubercles *giant cells* are formed by an increase in the protoplasm and in the nuclei of an individual cell, or possibly by the fusion of several cells. The giant cells seem to be in inverse ratio to the number and virulence of the bacilli.

(*c*) The Degeneration of Tubercle.—(1) *Caseation.*—At the central part of the growth, owing to the direct action of the bacilli or their products, a process of coagulation necrosis goes on in the cells, which lose their outline, become irregular, no longer take stains, and are finally converted into a homogeneous, structureless substance. Proceeding from the centre outward, the tubercle may be gradually converted into a yellowish-gray body, in which, however, the bacilli are still abundant. No blood vessels are found in them. Aggregated together these form ~~the~~ cheesy masses ~~so common in tuberculosis,~~ which may undergo softening, fibroid limitation (encapsulation), or calcification.

(2) *Sclerosis.*—With the necrosis of the cell elements at the centre of the tubercle, hyaline transformation proceeds, together with great increase in the fibroid elements; so that the tubercle is converted into a firm, hard structure. Often the change is rather of a fibro-caseous nature; but the sclerosis predominates. In some situations, as in the peritoneum, this seems to be the natural transformation ~~of tubercle~~, and it is by no means rare in the lungs.

In all tubercles two processes go on: the one—caseation—destructive and dangerous; and the other—sclerosis—conservative and healing. The ultimate result in a given case depends upon the capabilities of the body to fight the invaders. There are tissue-soils in which the bacilli are, in all probability, killed at once. There are others in which a lodgment is gained and more or less damage done, but finally the day is with the conservative, protecting forces. Thirdly, there are tissue-soils in which the bacilli grow luxuriantly, caseation and softening, not limitation and sclerosis, prevail, and the day is with the invaders.

The action of the bacilli injected directly into the blood-vessels illustrates many points in the histology and pathology of tuberculosis. If into the vein of a rabbit a pure culture of the bacilli is injected, the microbes accumulate chiefly in the liver and spleen. The animal dies usually within two weeks, and the organs apparently show no trace of tubercles. Microscopically, in both spleen and liver the young tubercles in process of formation are very numerous, and karyokinesis is going on in the liver-cells. After an injection of a more dilute culture, or one ~~whose~~ virulence ~~has been mitigated by age~~, instead of dying within a fortnight the animal survives for five or six weeks,

Maybe due to ① culture of ④ vasc. subst. nutritive. distilled
② active toxins of tub. bacillus.

by which time the tubercles are apparent in the spleen and liver, and often in the other organs.

(*d*) The Diffused Inflammatory Tubercle.—This is most frequently seen in the lungs and results from the fusion of many small foci of infection —so small indeed that they may not be visible to the naked eye, but which histologically are seen to be composed of scattered centres, surrounded by areas in which the air-cells are filled with the products of exudation and of the proliferation of the alveolar epithelium. Under the influence of the bacilli, caseation takes place, usually in small groups of lobules, occasionally in an entire lobe, or even the greater part of a lung. In the early stage of the process, the tissue has a gray gelatinous appearance, the *gray infiltration* of Laennec. The alveoli contain a sero-fibrinous fluid with cells, and the septa are also infiltrated. These cells accumulate and undergo coagulation necrosis, forming areas of caseation, the *infiltration tuberculeuse jaune* of Laennec, the scrofulous or cheesy pneumonia of later writers. There may also be a diffuse infiltration and caseation without any special foci, a widespread tuberculous pneumonia induced by the bacilli.

After all, the two processes are identical. As Baumgarten states: "There is no well-marked difference between miliary tubercle and chronic caseous pneumonia. Speaking histologically, miliary tuberculosis is nothing else than a chronic caseous miliary pneumonia, and chronic caseous pneumonia is nothing but a tuberculosis of the lungs."

(*e*) Secondary Inflammatory Processes.—(1) The irritation caused by the bacilli produces an inflammation which may, as has been described, be limited to exudation of leucocytes and serum, but may also be much more extensive, and vary with changing conditions. We find, for example, about the smaller tubercles in the lungs, pneumonia—either catarrhal or fibrinous—proliferation of the connective-tissue elements in the septa (which also become infiltrated with round cells), and changes in the blood and lymph-vessels.

(2) In processes of minor intensity the inflammation is of the slow reactive nature, which results in the production of a cicatricial connective tissue which limits and restricts the development of the tubercles and is the essential conservative element in the disease. It is to be remembered that in chronic pulmonary tuberculosis much of the fibroid tissue which is present is not in any way associated with the action of the bacilli.

(3) Suppuration. Do the bacilli themselves induce suppuration? In so-called cold tuberculous abscess the material is not histologically pus, but a *débris* consisting of broken-down cells and cheesy material. It is moreover sterile—that is, does not contain the usual pus organisms. The products of the tubercle bacilli are probably able to induce suppuration, as in joint and bone tuberculosis pus is frequently produced, although this may be due to a mixed infection. Tuberculin is one of the best agents for the production of experimental suppuration. In tuberculosis of the lungs the suppuration is largely the result of an infection with pus organisms.

II. ACUTE MILIARY TUBERCULOSIS

The modern knowledge of this remarkable form dates from the statement of Buhl (1856), that miliary tuberculosis is a specific infection dependent on

the presence in the body of an unencapsulated yellow tubercle, or a tuberculous cavity in the lung; and that it bears the same relation to the primary lesion as pyæmia does to a focus of suppuration.

Carl Weigert established the truth of this brilliant conception by demonstrating the association of miliary tuberculosis with tuberculosis of the blood-vessels. There are two groups of vessel tubercle—the tuberculous periangitis in which there is invasion of the adventitia, and the endangitis in which the tubercles start in the intima. The parts most frequently affected are the pulmonary veins and the thoracic duct, less often the jugular vein, the suprarenal and the vena cava superior, and the sinuses of the dura mater, the aorta, and the endocardium. To the branches of the pulmonary veins it is not uncommon to find caseous glands adherent, penetrating the walls and showing a growth of miliary tubercles in the intima. A special interest belongs to tuberculosis of the thoracic duct, first accurately described by Sir Astley Cooper. Benda in a series of 19 cases of vessel tuberculosis found in many instances an enormous number of bacilli, particularly in the caseous tubercles of the thoracic duct.

The bacilli do not increase in the blood, but settle in the different organs, producing a generalized tuberculosis, of which Weigert recognizes three types or grades: I. The acute general miliary tuberculosis, in which the various organs of the body are stuffed with miliary and submiliary nodules. II. A second form characterized by a small number of tubercles in one or many organs. III. The occurrence of numerous tuberculous foci widely spread throughout the body, but in a more chronic form; the tubercles are larger and many are caseous. It is the chronic generalized tuberculosis of children. Transitional forms between these groups occur. In the first variety, which we are here considering, there is an eruption into the circulation of an enormous number of bacilli. Benda suggests in explanation of the profound toxæmia seen in certain cases (the typhoid form) that in addition the blood is surcharged with toxins from a large caseous focus which has eroded the vessel.

Clinical Forms

The cases may be grouped into those with the symptoms of an *acute general infection*—the "typhoid" form; cases in which pulmonary symptoms predominate; and cases in which the *cerebral* or *cerebro-spinal* symptoms are marked—tuberculous meningitis.

Other forms have been recognized, but this division covers a large majority of the cases.

Taking any series of cases it will be found that the meningeal form of acute tuberculosis exceeds in numbers the cases with general or marked pulmonary symptoms.

General or Typhoid Form.—Symptoms.—The patient presents the symptoms of a profound infection which simulates and is frequently mistaken for typhoid fever. After a period of failing health, with loss of appetite, he becomes feverish and weak. Occasionally the disease sets in more abruptly, but in many instances the anamnesis closely resembles that of typhoid fever. Nose-bleeding, however, is rare. The temperature increases, the pulse becomes rapid and feeble, the tongue dry; delirium becomes marked and the cheeks are flushed. The pulmonary symptoms may be very slight; usually

Landouzy = acute tuberculous septicaemia

Lesions of congestion + degeneration - do not reach tubercle as pat. dies rapidly or sues to recovery =

d/

? acute adhesive stage of both acute of gen + pulmonary. It is usually [illegible]

bronchitis exists, but is not more severe than is common with typhoid fever. The pulse is seldom dicrotic, but is rapid in proportion to the pyrexia. Perhaps the most striking feature of the temperature is the irregularity; and if seen from the outset there is not the steady ascent noted in typhoid fever. There is usually an evening rise to 103° F., sometimes 104° F., and a morning remission of from two to three degrees. Sometimes the pyrexia is intermittent, and the thermometer may register below normal during the early morning hours. The inverse type of temperature, in which the rise takes place in the morning, is held by some writers to be more frequent in general tuberculosis than in other diseases. In rare instances there may be little or no fever. On two occasions I have had a patient admitted to my wards in a condition of profound debility, with a history of illness of from three to four weeks' duration, with rapid pulse, flushed cheeks, dry tongue, and very slight elevation in temperature, in whom (post mortem) the condition proved to be general tuberculosis. In one instance there was tolerably extensive disease at the right apex. Reinhold, from Bäumler's clinic, has called attention to these afebrile forms of acute tuberculosis. In 9 of 52 cases there was no fever, or only a transient rise.

In a considerable number of the cases the respirations are increased in frequency, particularly in the early stage, and there may be signs of diffuse bronchitis and slight cyanosis. Cheyne-Stokes breathing occurs toward the close.

Active delirium is rare. More commonly there are torpor and dullness, gradually deepening into coma, in which the patient dies. In some cases the pulmonary symptoms become more marked; in others meningeal or cerebral features occur.

Diagnosis.—The differential diagnosis between general miliary tuberculosis without local manifestations and typhoid fever is extremely difficult. A point of importance, ~~to which reference has already been made,~~ is the irregularity of the temperature curve. The greater frequency of the respirations and the tendency to slight cyanosis are much more common in tuberculosis. There are cases, however, of typhoid fever in which the initial bronchitis is severe and may lead to dyspnœa and disturbed oxygenation. The cough may be slight or absent. Diarrhœa is rare in tuberculosis; the bowels are usually constipated; but diarrhœa may occur and persist for days. In certain cases the diagnosis has been complicated still further by the occurrence of blood in the stools. Enlargement of the spleen occurs in general tuberculosis, but is neither so early nor so marked as in typhoid fever. In children, however, the enlargement may be considerable. The urine may show traces of albumin, and ~~unfortunately~~ Ehrlich's diazo-reaction, ~~which is so constant in typhoid fever,~~ is also met with in general tuberculosis. The absence of the characteristic roseola is an important feature. Occasionally in acute tuberculosis reddish spots may occur and for a time cause difficulty, but they do not come out in crops, and rarely have the characters of the true typhoid eruption. Herpes is perhaps more common in tuberculosis. Toward the close, petechiæ may appear on the skin, particularly about the wrists. A rare event is jaundice, due possibly to the eruption of tubercles in the liver. It is to be remembered that the lesions of acute tuberculosis and of typhoid fever have been demonstrated in the same body.

A negative Widal test or ophthalmo-reaction, and the absence of typhoid bacilli in blood-cultures may be of decisive importance in these doubtful cases. In very rare instances tubercle bacilli have been found in the blood. Leucocytosis is more common in miliary tuberculosis than in typhoid fever, in which leucopenia is the rule. Careful examination of the eyes may show choroidal tubercles, though I have never known a diagnosis made on their presence alone. In the fluid obtained by lumbar puncture the tubercle bacilli may be abundant, even when there is no active meningitis. In a few cases the bacilli have been found in the urine.

Pulmonary Form.—Symptoms.—From the outset the pulmonary symptoms are marked. The patient may have had a cough for months or for years without much impairment of health, or he may be known to be the subject of chronic pulmonary tuberculosis. In other instances, particularly in children, the affection follows measles or whooping cough, and is of a distinctly broncho-pneumonic type. The disease begins with the symptoms of diffuse bronchitis. The cough is marked, the expectoration muco-purulent, occasionally rusty. Hæmoptysis has been noted in a few instances. From the outset dyspnœa is a striking feature and may be out of proportion to the intensity of the physical signs. There is more or less cyanosis of the lips and finger-tips, and the cheeks are suffused. Apart from emphysema and the later stages of severe pneumonia, I know of no other pulmonary condition in which the cyanosis is so marked. The physical signs are those of bronchitis. In children there may be defective resonance at the bases, from scattered areas of broncho-pneumonia; or, what is equally suggestive, areas of hyper-resonance. Indeed, the percussion note, particularly in the front of the chest, in some cases of miliary tuberculosis, is full and clear, and it will be noted (post mortem) that the lungs are unusually voluminous. This is probably the result of more or less widespread acute emphysema. On auscultation, the râles are either sibilant and sonorous or small, fine, and crepitant. There may be fine crepitation from the occurrence of tubercles on the pleura (Jürgensen). In children there may be high-pitched tubular breathing at the bases or toward the root of the lung. Toward the close the râles may be larger and more mucous. The temperature rises to 102° or 103° F., and may present the inverse type. The pulse is rapid and feeble. In the very acute cases the spleen is always enlarged. The disease may prove fatal in ten or twelve days, or may be protracted for weeks or even months.

Diagnosis.—The diagnosis of this form offers less difficulty and is more frequently made. There is often a history of previous cough, or the patient is known to be the subject of local disease of the lung, or of the lymph glands, or of the bones. In children these symptoms following measles or whooping cough indicate in the majority of cases acute miliary tuberculosis, with or without broncho-pneumonia. Occasionally the sputum contains tubercle bacilli.

The choroidal tubercle occurs in a limited number of cases and may help the diagnosis. More important in an adult is the combination of dyspnœa with cyanosis and the signs of a diffuse bronchitis. In some instances the occurrence of cerebral symptoms at once gives a clew to the nature of the trouble.

Meningeal Form (*Tuberculous Meningitis, Basilar Meningitis*).—This af-

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fection, which is also known as acute hydrocephalus or "water on the brain," is essentially an acute tuberculosis in which the membranes of the brain, sometimes of the cord, bear the brunt of the attack. Our first accurate knowledge of this affection dates from the publication of Robert Whytt's Observations on the Dropsy of the Brain, Edinburgh, 1768. He studied 20 cases and divided the disease into three stages, according to the condition of the pulse.

Though Guersant had as early as 1827 used the name *granular meningitis* for this form of inflammation of the meninges, it was not until 1830 that Papavoine demonstrated the nature of the granules and noted their occurrence with tubercles in other parts.

In 1832 and 1833, W. W. Gerhard, of Philadelphia, made a very careful study of the disease in the Children's Hospital at Paris, and his publications, more than those of any other author, served to place the disease on a firm anatomical and clinical basis.

There are several special *etiological* factors in connection with this form. It is much more common in children than in adults. It occurs during the first year of life, but is more frequent between the second and the fifth years. In a majority of the cases a focus of old tuberculous disease will be found, commonly in the bronchial or mesenteric glands. In a few instances the affection seems to be primary in the meninges. It is very difficult, however, in an ordinary post mortem to make an exhaustive search, and the lesion may be in the bones, sometimes in the middle ear, or in the genito-urinary organs. In those instances in which no primary focus has been discovered it has been suggested that the bacilli reach the meninges through the cribriform plate of the ethmoid from the upper part of the nostrils, but this is not probable.

Morbid Anatomy.—The meninges at the base are most involved, hence the term basilar meningitis. The parts about the optic chiasm, the Sylvian fissures, and the interpeduncular space are affected. There may be only slight turbidity and matting of the membranes, and a certain stickiness with serous infiltration; but more commonly there is a turbid exudate, fibrino-purulent in character, which covers the structures at the base, surrounds the nerves, extends into the Sylvian fissures, and appears on the lateral, rarely on the upper, surfaces of the hemispheres. The tubercles may be very apparent, particularly in the Sylvian fissures, appearing as small, whitish nodules on the membranes. They vary much in number and size, and may be difficult to find. The amount of exudate bears no definite relation to the abundance of tubercles. The arteries of the anterior and posterior perforated spaces should be carefully withdrawn and searched, as upon them nodular tubercles may be found when not present elsewhere. In doubtful cases the middle cerebral arteries should be very carefully removed, spread on a glass plate with a black background, and examined with a lens. The tubercles are then seen as nodular enlargements on the smaller arteries. The lateral ventricles are dilated (acute hydrocephalus) and contain a turbid fluid; the ependyma may be softened, and the septum lucidum and fornix are usually broken down. The convolutions are often flattened and the sulci obliterated owing to the increased intra-ventricular pressure. The meninges are not alone involved, but the contiguous cerebral substance is more or less œdematous and infil-

trated with leucocytes, so that anatomically the condition is in reality a *meningo-encephalitis.*

There are instances in which the acute process is associated with chronic meningeal tuberculosis; cases which may for months present the clinical picture of brain tumor. Although in a majority of instances the process is cerebral, the spinal meninges may also be involved, particularly those of the cervical cord. There are cases, indeed, in which the symptoms are chiefly spinal.

Symptoms.—Tuberculous meningitis presents an extremely complex clinical picture. It will be best to describe the form found in children.

Prodromal symptoms are common. The child may have been in failing health for some weeks, or may be convalescent from measles or whooping cough. In many instances there is a history of a fall. The child gets thin, is restless, peevish, irritable, loses its appetite, and the disposition may completely change. Symptoms pointing to the disease may then set in, either quite suddenly with a convulsion, or more commonly with headache, vomiting, and fever, three essential symptoms of the onset which are rarely absent. The pain may be intense and agonizing. The child puts its hand to its head and occasionally, when the pain becomes worse, gives a short, sudden cry, the so-called hydrocephalic cry. Sometimes the child screams continuously until utterly exhausted. The vomiting is without apparent cause, and is independent of taking of food. Constipation is usually present. The fever is slight, but gradually rises to 102° to 103° F. The pulse is at first rapid, subsequently irregular and slow. The respirations are rarely altered. During sleep the child is restless and disturbed. There may be twitchings of the muscles, or sudden startings; or the child may wake up from sleep in great terror. In this early stage the pupils are usually contracted. These are the chief symptoms of the initial stage, or, as it is termed, the *stage of irritation.*

In the second period of the disease these irritative symptoms subside; vomiting is no longer marked, the abdomen becomes retracted, boat-shaped, or *carinated.* The bowels are obstinately constipated, the child no longer complains of headache, but is dull and apathetic, and when roused is more or less delirious. The head is often retracted and the child utters an occasional cry. The pupils are dilated or irregular, and a squint may develop. Sighing respiration is common. Convulsions may occur, or rigidity of the muscles of one side or of one limb. The temperature is variable, ranging from 100° to 102.5° F. A blotchy erythema is not uncommon on the skin. If the fingernail is drawn across the skin of any region a red line comes out quickly, the so-called *tache cérébrale,* which, however, has no diagnostic significance.

In the final period, or stage of *paralysis,* the coma increases and the child can not be roused. Convulsions are not infrequent, and there are spasmodic contractions of the muscles of the back and neck. Spasms may occur in the limbs of one side. Optic neuritis and paralysis of the ocular muscles may be present. The pupils become dilated, the eyelids are only partially closed, and the eyeballs are rolled up so that the corneæ are only uncovered in part by the upper eyelids. Diarrhœa may occur, the pulse becomes rapid, and the child may sink into a typhoid state with dry tongue, low delirium, and involuntary passages of urine and fæces. The temperature often becomes subnormal, sinking in rare instances to 93° or 94° F. In some cases there is an ante-mortem elevation of temperature, the fever rising to 106° F. The entire

Symptoms may vary. Some due to
Economic rather than local
lesions.

duration of the disease is from a fortnight to three or four weeks. A leucocytosis is not infrequently present throughout the disease.

There are cases of tuberculous meningitis which pursue a more rapid course. They set in with great violence, often in persons apparently in good health, and may prove fatal within a few days. In these instances, more commonly seen in adults, the convex surface of the brain is usually involved. There are again instances which are essentially chronic and display symptoms of a limited meningitis, sometimes with pronounced psychical symptoms, and sometimes with those of cerebral tumor.

There are certain features which call for special comment.

The irregularity and slowness of the pulse in the early and middle stages of the disease are points upon which all authors agree. Toward the close, as the heart's action becomes weaker, the pulsations are more frequent. The temperature is usually elevated, but there are instances in which it does not rise in the whole course of the disease much above 100° F. It may be extremely irregular, and the oscillations are often as much as three or four degrees in the day. Toward the close the temperature may sink to 95° F., occasionally to 94° F., or there may be hyperpyrexia. In a case of Bäumler's the temperature rose before death to 43.7° C. (110.7° F.).

The ocular symptoms of the disease are of special importance. In the early stages narrowing of the pupils is the rule. Toward the close, with increase in the intra-cranial pressure, the pupils dilate and are irregular. There may be conjugate deviation of the eyes. Of ocular nerves the third is most frequently involved, sometimes with paralysis of the face, limbs, and hypoglossal nerve on the opposite side (syndrome of Weber), due to a lesion limited to the inferior and internal part of the crus. The changes in the retinæ are very important. Neuritis is the most common. According to Gowers, the disk at first becomes full colored and has hazy outlines, and the veins are dilated. Swelling and striation become pronounced, but the neuritis is rarely intense. Of 26 cases studied by Garlick, in 6 the condition was of diagnostic value. The tubercles in the choroid are rare and much less frequently seen during life than post mortem figures would indicate. Thus, Litten found them (post mortem) in 39 out of 52 cases. They were present in only 1 of the 26 cases of tuberculous meningitis examined by Garlick. Heinzel examined with negative results 41 cases.

Among the motor symptoms convulsions are most common, but there are other changes which deserve special mention. A tetanic contraction of one limb may persist for several days, or a cataleptic condition. Tremor and athetoid movements are sometimes seen. The paralyses are either hemiplegias or monoplegias. Hemiplegia may result from disturbance in the cortical branches of the middle cerebral artery, occasionally from softening in the internal capsule, due to involvement of the central branches. Of monoplegias, that of the face is perhaps most common, and if on the right side it may occur with aphasia. In two of my cases in adults aphasia occurred. Brachial monoplegia may be associated with it. In the more chronic cases the symptoms persist for months, and there may be a characteristic Jacksonian epilepsy. Kernig's sign may be present, but is not constant. The Babinski reflex is sometimes found.

The DIAGNOSIS of tuberculous meningitis is rarely difficult, and points

upon which special stress is to be laid are the existence of a tuberculous focus in the body, the mode of onset and the symptoms, and the evidence obtained on lumbar puncture. The fluid withdrawn is turbid, under increased pressure, and the protein content is increased. By centrifugalization, careful staining, and long search, tubercle bacilli can be found in a large proportion of cases—in 135 of 137 in one series (Hemenway). The cells are usually much increased in number and a large percentage (over 90 per cent.) are small mononuclear lymphocytes, though occasionally an excess of polymorphonuclear leucocytes is found.

The PROGNOSIS in this form of meningitis is always most serious. I have neither seen a case which I regarded as tuberculous recover, nor have I seen post mortem evidence of past disease of this nature. Cases of recovery have been reported by reliable authorities, but they are extremely rare, and there is always a reasonable doubt as to the correctness of the diagnosis. The differential features and treatment are considered in connection with acute meningitis.

III. TUBERCULOSIS OF THE LYMPHATIC SYSTEM

1. *Tuberculosis of the Lymph-glands (Scrofula)*

Scrofula is tubercle, as it has been shown that the bacillus of Koch is the essential element. Formerly special attention was given to different types of scrofula, of which two important forms were recognized—the sanguine, in which the child was slightly built, tall, with small limbs, a fine clear skin, soft silky hair, and was mentally very bright and intelligent; and the phlegmatic type, in which the child was short and thick-set, with coarse features, muddy complexion, and a dull, heavy aspect. It is not yet definitely settled whether the virus which produces the chronic tuberculous adenitis or scrofula differs from that which produces tuberculosis in other parts, or whether it is the local conditions in the glands which account for the slow development and milder course. The observations of Lingard are important as showing a variation in the virulence of the tubercle bacillus. Guinea-pigs inoculated with ordinary tubercle showed lymphatic infection within the first week, and the animals died within three months; infected with material from scrofulous glands, the lymphatic enlargement did not appear until the second or third week, and the animals survived for six or seven months. He showed, moreover, that the virulence of the infection obtained from the scrofulous glands increased in intensity by passing through a series of guinea-pigs. In a certain number of cases the infection is with the bovine germ, but exactly in what proportion, and with what special clinical features has not yet been determined.

Tuberculous adenitis, met with at all ages, is more common in children than in adults, and may occur in old age.

Tubercle bacilli are ubiquitous; all are exposed to infection, and upon the local conditions, whether favorable or unfavorable, depends the fate of those organisms which find lodgment in our bodies. A special predisposing factor in lymphatic tuberculosis is catarrh of the mucous membranes, which in itself excites slight adenitis of the neighboring glands. In a child with constantly recurring naso-pharyngeal catarrh, the bacilli which lodge on the mucous membranes find in all probability the gateways less strictly guarded and are

Very small & spindels with pul. tubercl shew scars.
e.g. in 64 of 2000 patients 3.2%.

taken up by the lymphatics and passed to the nearest glands. The importance of the tonsils as an infection-atrium has of late been urged. In conditions of health the local resistance, or, as some would put it, the phagocytes, would be, active enough to deal with the invaders, but the irritation of a chronic catarrh weakens the resistance of the lymph-tissue, and the bacilli are enabled to grow and gradually to change a simple into a tuberculous adenitis. The frequent association of tuberculous adenitis of the bronchial glands with whooping cough and with measles, and the association of tubercle in the mesenteric glands in children with intestinal catarrh, find in this way a rational explanation.

The following are some of the features of interest in tuberculous adenitis:

(*a*) The local character of the disease. Thus, the glands of the neck, or at the bifurcation of the bronchi, or those of the mesentery, may be alone involved.

(*b*) The tendency to spontaneous healing. In a large proportion of the cases the battle which ensues between the bacilli and the protective forces is long; but the latter are finally successful, and we find in the calcified remnants in the bronchial and mesenteric lymph-glands evidences of victory. Too often in the bronchial glands a truce only is declared and hostilities may break out afresh in the form of an acute tuberculosis.

(*c*) The tendency of tuberculous adenitis to pass on to suppuration. The frequency with which, particularly in the glands of the neck, we find the tuberculous processes associated with suppuration is a special feature of this form of adenitis. In nearly all instances the pus is sterile. Whether the suppuration is excited by the bacilli or by their products, or whether it is the result of a mixed infection with pus organisms, which are subsequently destroyed, has not been settled.

(*d*) The existence of an unhealed tuberculous adenitis is a constant menace to the organism. It is safe to say that in three-fourths of the instances of acute tuberculosis the infection is derived from this source. On the other hand, it has been urged that "scrofula" in childhood gives immunity in adult life. We certainly do meet with many persons of exceptional bodily vigor who in childhood had enlarged glands, but the evidence which Marfan brings forward in support of this view is not conclusive.

Generalized Tuberculous Lymphadenitis.—In exceptional instances we find diffuse tuberculosis of nearly all the lymph-glands of the body with little or no involvement of other parts. The most extreme cases of it, which I have seen, have been in negro patients. Two well-marked cases occurred at the Philadelphia Hospital. In a woman, the chart from April, 1888, until March, 1889, showed persistent fever, ranging from 101° to 103° F., occasionally rising to 104° F. On December 16th the glands on the right side of the neck were removed. After an attack of erysipelas, on February 17th, she gradually sank and died March 5th. The lungs presented only one or two puckered spots at the apices. The bronchial, retro-peritoneal, and mesenteric glands were greatly enlarged and caseous. There was no intestinal, uterine, or bone disease. The continuous high fever in this case depended apparently upon the tuberculous adenitis, which was much more extensive than was supposed during life. In these instances the enlargement is most marked in the retro-peritoneal, bronchial, and mesenteric glands, but may be

also present in the groups of external glands. Occurring acutely, it presents a picture resembling Hodgkin's disease. In a case which died in the Montreal General Hospital this diagnosis was made. The cervical and axillary glands were enormously enlarged, and death was caused by infiltration of the larynx. In infants and children there is a form of general tuberculous adenitis in which the various groups of glands are successively, more rarely simultaneously, involved, and in which death is caused either by cachexia or by an acute infection of the meninges.

Local Tuberculous Adenitis.—(*a*) CERVICAL.—This is the most common form met with in children. It is seen particularly among the poor and those who live continuously in the impure atmosphere of badly ventilated lodgings. Children in foundling hospitals and asylums are specially prone to the disease. In the United States it is most common in the negro race. As already stated, it is often met with in catarrh of the nose and throat, or chronic enlargement of the tonsils; or the child may have had eczema of the scalp or a purulent otitis.

The submaxillary glands are first involved, and are popularly spoken of as enlarged *kernels*. They are usually larger on one side than on the other. As they increase in size, the individual tumors can be felt; the surface is smooth and the consistence firm. They may remain isolated, but more commonly they form large, knotted masses, over which the skin is, as a rule, freely movable. In many cases the skin ultimately becomes adherent, and inflammation and suppuration occur. An abscess points and, unless opened, bursts, leaving a sinus which heals slowly. The disease is frequently associated with coryza, with eczema of the scalp, ear, or lips, and with conjunctivitis or keratitis. When the glands are large and growing actively there is fever. The subjects are usually anæmic, particularly if suppuration has occurred. The progress of this form of adenitis is slow and tedious. Death, however, rarely follows, and many aggravated cases in children get well. Not only the submaxillary group, but the glands above the clavicle and in the posterior cervical triangle, may be involved. In other instances the cervical and axillary glands are involved together, forming a continuous chain which extends beneath the clavicle and the pectoral muscle. With them the bronchial glands may also be enlarged and caseous. Not infrequently the enlargement of the supra-clavicular and axillary group of glands on one side precedes a tuberculous pleurisy or pulmonary tuberculosis.

(*b*) TRACHEO-BRONCHIAL.—The mediastinal lymph-glands constitute filters in which lodge the various foreign particles which escape the normal phagocytes of bronchi and lungs. Among these foreign particles, and probably attached to them, tubercle bacilli are not uncommon, and we find tubercles and caseous matter with great frequency in this group. Northrup found them involved in every one of 127 cases of tuberculosis at the New York Foundling Hospital. This tuberculous adenitis may, in the bronchial glands, attain the dimensions of a tumor of large size. In children the bronchial adenitis is apt to be associated with suppuration. The glands at the bifurcation of the trachea are first involved and chiefly on the right side—in 74 per cent. of Wollstein's cases. Irregular fever, failure of nutrition, loss of appetite, and lassitude may be caused by the absorption of toxins; pain is rare, though it is complained of sometimes in the mammary region. The cough

said that it children on rgt. side only. - Give one opinions
dumb b.17. Arrow & Dorsal spines

is paroxysmal, often brassy, so that it has been mistaken for whooping cough. Stridor, when present, is more often expiratory. The physical signs are not very definite. Dilated veins over the anterior aspect of the thorax, absence of descent of the larynx during inspiration, and pain on pressure over the upper dorsal vertebræ are mentioned. Extension of the normal dulness over the upper four thoracic vertebræ to the fifth and sixth is of importance, and there may be para-vertebral dulness on delicate percussion. Some writers lay stress upon the bronchophony over the upper thoracic vertebræ, and a venous hum may be heard sometimes over the manubrium. The X-ray pictures are regarded by experts as distinctive, showing the shadow extending from either side of the spine.

Some of the more uncommon effects are the following: Compression of the superior cava, of the pulmonary artery, and of the azygos vein. The trachea and bronchi, though often flattened, are rarely seriously compressed. The pneumogastric nerve may be involved, particularly the recurrent laryngeal branch. More important ~~really~~ are the perforations of the enlarged and softened glands into the bronchi or trachea, or a sort of secondary cyst may be formed between the lung and the trachea. Asphyxia has been caused by blocking of the larynx by a caseous gland which has ulcerated through the bronchus (Voelcker), and Cyril Ogle ~~has~~ reported a case in which the ulcerated gland practically occluded both bronchi. Perforations of the vessels are much less common, but the pulmonary artery and the aorta have been opened. Perforation of the œsophagus has been described in several cases. One of the most serious effects is infection of the lung or pleura by the caseous glands situated deep along the bronchi. This may, as is often clearly seen, be by direct contact, and it may be difficult to determine in some sections where the caseous bronchial gland terminates and the pulmonary tissue begins. In other instances it takes place along the root of the lung and is subpleural. Among other sequences may be mentioned diverticulum of the œsophagus following adhesion of an enlarged gland and its subsequent retraction; and, in the case of the anterior mediastinal and aortic groups, the frequent production of pericarditis, either by contact or by rupture of a softened gland into the sac.

A serious danger is systemic infection, which takes place through the vessels.

(*c*) Mesenteric; Tabes mesenterica.—In this affection, the abdominal scrofula of old writers, the glands of the mesentery and retro-peritoneum become enlarged and caseate; more rarely they suppurate or calcify. A slight tuberculous adenitis is extremely common in children, and is often accidentally found (post mortem) when they have died of other diseases. It may be a primary lesion associated with intestinal catarrh, or it may be secondary to tuberculous disease of the intestines.

The statistics of abdominal tuberculosis show a great variation in different localities. The small percentage in New York, less than one per cent. of all cases (Bovaird and Mt. Sinai Hospital figures), contrasts with the high figures given for Scotland by John Thomson, 3.57 for Edinburgh and 4.51 for Glasgow. The general involvement of the glands interferes seriously with nutrition, and the patients are puny, wasted, and anæmic. The abdomen is enlarged and tympanitic; diarrhœa is a constant feature; the stools are thin

and offensive. There is moderate fever, but the general wasting and debility are the most characteristic features. The enlarged glands can not often be felt, owing to the distended condition of the bowels. These cases are often spoken of as consumption of the bowels, but in a majority of them the intestines do not present tuberculous lesions. In a considerable number of the cases of tabes mesenterica the peritoneum is also involved, and in such the abdomen is large and hard, and nodules may be felt.

In adults tuberculous disease of the mesenteric glands may occur as a primary affection, or in association with pulmonary disease. Large tumors may exist without tuberculous disease in the intestines or in any other part.

2. *Tuberculosis of the Serous Membranes*

General Serous Membrane Tuberculosis (*Polyorrhomenitis*).—The serous membranes may be chiefly involved, simultaneously or consecutively, presenting a distinctive and readily recognizable clinical type of tuberculosis. There are three groups of cases. First, those in which an acute tuberculosis of the peritoneum and pleuræ occurs rapidly, caused by local disease of the tubes in women, or of the mediastinal or bronchial lymph-glands. Secondly, cases in which the disease is more chronic, with exudation into both peritoneum and pleuræ, the formation of cheesy masses, and the occurrence of ulcerative and suppurative processes. Thirdly, there are cases in which the pleuro-peritoneal affection is still more chronic, the tubercles hard and fibroid, the membranes much thickened, and with little or no exudate. In any one of these three forms the pericardium may be involved with the pleuræ and peritoneum. It is important to bear in mind that there may be no visceral tuberculosis in these cases.

Tuberculosis of the Pleura.—(*a*) Acute Tuberculous Pleurisy.—It is difficult ~~in the present state of our knowledge~~ to estimate the proportion of instances of acute pleurisy due to tuberculosis (see Acute Pleurisy). The cases are rarely fatal. Here, too, there are three groups of cases: (1) Acute tuberculous pleurisy with subsequent chronic course. (2) Secondary and terminal forms of acute pleurisy (these are not uncommon in hospital practice). And (3) a form of acute tuberculous suppurative pleurisy. A considerable number of the purulent pleurisies, designated as latent and chronic, are caused by tubercle bacilli, but the fact is not so widely recognized that there is an acute, ulcerative, and suppurative disease which may run a very rapid course. The pleurisy sets in abruptly, with pain in the side, fever, cough, and sometimes with a chill. There may be nothing to suggest a tuberculous process, and the subject may have a fine physique and come of healthy stock.

(*b*) The subacute and chronic tuberculous pleurisies are more common. The largest group of cases comprises those with sero-fibrinous effusion. The onset is insidious, the true character of the disease is frequently overlooked, and in almost every instance there are tuberculous foci in the lungs and in the bronchial glands. These are cases in which the termination is often in pulmonary tuberculosis or general miliary tuberculosis. In a few cases the exudate becomes purulent.

(c) And, lastly, there is a *chronic adhesive pleurisy*, a primary proliferative form which is of long standing, may lead to very great thickening of the membrane, and sometimes to invasion of the lung.

Secondary tuberculous pleurisy is very common. The visceral layer is always involved in pulmonary tuberculosis. Adhesions usually form and a chronic pleurisy results, which may be simple, but usually tubercles are scattered through the adhesions. An acute tuberculous pleurisy may result from direct extension. The fluid may be sero-fibrinous or hæmorrhagic, or may become purulent. And, lastly, a very common event in pulmonary tuberculosis is the perforation of a superficial spot of softening, and the production of *pyo-pneumothorax.*

The general symptomatology of these forms will be considered under disease of the pleura.

Tuberculosis of the Pericardium.—Miliary tubercles may occur as a part of a general infection, but the term is properly limited to those cases in which, either as a primary or secondary process, there is extensive disease of the membrane. Tuberculosis is not so common in the pericardium as in the pleura and peritoneum, but it is certainly more common than the literature would lead us to suppose. George Norris found 82 instances among 1,780 post mortems in tuberculous subjects.

We may recognize four groups of cases: First, those in which the condition is entirely latent, and the disease is discovered accidentally in individuals who have died of other affections or of chronic pulmonary tuberculosis.

A second group, in which the symptoms are those of cardiac insufficiency following the dilatation and hypertrophy consequent upon a chronic adhesive pericarditis. The symptoms are those of cardiac dropsy, and suggest either idiopathic hypertrophy and dilatation, or, if there is a loud blowing systolic murmur at the apex, mitral valve disease, either insufficiency or stenosis. The condition of adherent pericardium is usually overlooked.

In a third group the clinical picture is that of an acute tuberculosis, either general or with cerebro-spinal manifestations, which has had its origin from the tuberculous pericardium or tuberculous mediastinal lymph-glands.

A fourth group, with symptoms of acute pericarditis, includes cases in which the affection is acute and accompanied with more or less exudation of a sero-fibrinous, hæmorrhagic, or purulent character. There may be no suspicion whatever of the tuberculous nature of the trouble.

Tuberculosis of the Peritoneum.—In connection with miliary and chronic pulmonary tuberculosis it is not uncommon to find the peritoneum studded with small gray granulations. They are constantly present on the serous surface of tuberculous ulcers of the intestines. Apart from these conditions the membrane is often the seat of extensive tuberculous disease, which occurs in the following forms:

(*a*) *Acute miliary tuberculosis* with sero-fibrinous or bloody exudation.

(*b*) *Chronic tuberculosis,* characterized by larger growths, which tend to caseate and ulcerate. The exudate is purulent or sero-purulent, and is often sacculated.

(*c*) *Chronic fibroid tuberculosis,* which may be subacute from the onset, or which may represent the final stage of an acute miliary eruption. The tubercles are hard and pigmented. There is little or no exudation, and the serous surfaces are matted together by adhesions.

The process may be primary and local, which was the case in 5 of 17 post mortems. In children the infection appears to pass from the intestines,

and in adults this is the source in the cases associated with chronic phthisis. In women the disease extends commonly from the Fallopian tubes. In at least 30 or 40 per cent. of the instances of laparotomy in this affection reported by gynæcologists the infection was from them. The prostate or the seminal vesicles may be the starting-point. In many cases the peritoneum is involved with the pleura and pericardium, particularly with the former membrane.

It is interesting to note that certain morbid conditions of the abdominal organs predispose to the development of the disease; thus patients with cirrhosis of the liver very often die of an acute tuberculous peritonitis. The frequency with which the condition is met with in operations upon ovarian tumors has been commented upon by gynæcologists. Many cases have followed trauma of the abdomen. An very interesting feature is the occurrence of tuberculosis in hernial sacs. The condition is not very uncommon. In a majority of the instances it has been discovered accidentally during the operation for radical cure or for strangulation. In 7 instances the sac alone was involved.

It is generally stated that males are attacked oftener than females, but in the collected statistics I find the cases to be twice as numerous in females as in males; in the ratio, indeed, of 131 to 60.

Tuberculous peritonitis occurs at all ages. It is common in children associated with intestinal and mesenteric disease. The incidence is most frequent between the ages of twenty and forty. It may occur in advanced life. In one of my cases the patient was eighty-two years of age. Of 357 cases collected by me from the literature, there were under ten years, 27; between ten and twenty, 75; from twenty to thirty, 87; between thirty and forty, 71; from forty to fifty, 61; from fifty to sixty, 19; from sixty to seventy, 4; above seventy, 2. In America it is more common in the negro than in the white race. More blacks than whites, 77 to 70, were admitted to the Johns Hopkins Hospital (Hamman).

Symptoms.—In certain special features the tuberculous varies considerably from other forms of peritonitis. It presents a symptom-complex of extraordinary diversity.

In the first place, the process may be *latent* and met with accidentally in the operation for hernia or for ovarian tumor. The *acute onset* is not uncommon. Four cases in our records were diagnosed appendicitis, two acute cholecystitis, and six had symptoms of intestinal obstruction, in two of these coming on with great abruptness (Hamman). The cases have been mistaken for strangulated hernia. Other cases set in acutely with fever, abdominal tenderness, and the symptoms of ordinary acute peritonitis. Cases with a slow onset, abdominal tenderness, tympanites, and low continuous fever are often mistaken for *typhoid fever*.

Ascites is frequent, but the effusion is rarely large. It is sometimes hæmorrhagic. In this form the diagnosis may rest between an acute miliary cancer, cirrhosis of the liver, and a chronic simple peritonitis—conditions which usually offer no special difficulties in differentiation. A most important point is the simultaneous presence of a pleurisy. The tuberculin test may be used. *Tympanites* may be present in the very acute cases, when it is due to loss of tone in the intestines, owing to inflammatory infiltration; or

(iii)

saw

it may occur in the old, long-standing cases when universal adhesion has taken place between the parietal and visceral layers. *Fever* is a marked symptom in the acute cases, and the temperature may reach 103° or 104°. In many instances the fever is slight. In the more chronic cases subnormal temperatures are common, and for days the temperature may not rise above 97°, and the morning record may be as low as 95.5°. An occasional symptom is pigmentation of the skin, which ~~in some cases~~ has led to the diagnosis of Addison's disease. A striking peculiarity of tuberculous peritonitis is the frequency with which ~~(the condition)~~ either simulates or is associated with *tumor*. This may be:

(*a*) *Omental,* due to puckering and rolling of this membrane until it forms an elongated firm mass, attached to the transverse colon and lying athwart the upper part of the abdomen. This cord-like structure is found also with cancerous peritonitis, but is much more common in tuberculosis. Gairdner ~~has~~ called special attention to this form of tumor, and in children ~~has seen,~~ it undergo gradual resolution. A resonant percussion note may sometimes be elicited above the mass. Though usually situated near the umbilicus, the omental mass may form a prominent tumor in the right iliac region.

(*b*) *Sacculated exudation,* in which the effusion is limited and confined by adhesions between the coils, the parietal peritoneum, the mesentery, and the abdominal or pelvic organs. This encysted exudate is most common in the middle zone, and has frequently been mistaken for ovarian tumor. It may occupy the entire anterior portion of the peritoneum, or there may be a more limited saccular exudate on one side or the other. Within the pelvis it is associated with disease of the Fallopian tubes. Eighteen cases in the gynæcological wards (J. H. H.) were operated upon for pyosalpinx (Hamman).

(*c*) In rare cases the tumor formations may be due to great retraction or thickening of the *intestinal coils.* The small intestine is found shortened, the walls enormously thickened, and the entire coil may form a firm knot close against the spine, giving on examination the idea of a solid mass. Not the small intestine only, but the entire bowel from the duodenum to the rectum, has been found forming such a hard nodular tumor.

(*d*) *Mesenteric glands,* which occasionally form very large, tumor-like masses, more commonly found in children than in adults. This condition may be confined to the abdominal glands. Ascites may coexist. The condition must be distinguished from that in children, in which, with ascites or tympanites—sometimes both—there can be felt irregular nodular masses, due to large caseous formations between the intestinal coils. No doubt in a considerable number of cases of the so-called tabes mesenterica, particularly in those with enlargement and hardness of the abdomen—the condition which the French call *carreau*—there is involvement also of the peritoneum.

The *diagnosis* of these peritoneal tumors is sometimes very difficult. The omental mass is a less frequent source of error than any other; but, ~~as already mentioned,~~ a similar condition may occur in cancer. The most important problem is the diagnosis of the saccular exudation from ovarian tumor. In fully one-third of the recorded cases of laparotomy in tuberculous peritonitis the diagnosis of cystic ovarian disease had been made. The most suggestive points for consideration are the history ~~of the patient,~~ and the evidence of

old tuberculous lesions. The physical condition is not of much help, as in many instances the patients have been robust and well nourished. Irregular febrile attacks, gastro-intestinal disturbance, and pains are more common in tuberculous disease. Unless inflamed there is usually not much fever with ovarian cysts. The local signs are very deceptive, and in certain cases have conformed in every particular to those of cystic disease. The outlines in saccular exudation are rarely so well defined. The position and form may be variable, owing to alterations in the size of the coils of which in parts the walls are composed. Nodular cheesy masses may sometimes be felt at the periphery. Depression of the vaginal wall is mentioned as occurring in encysted peritonitis; but it is also found in ovarian tumor. Lastly, the condition of the Fallopian tubes, of the lungs and the pleuræ, should be thoroughly examined. The association of salpingitis with an ill-defined anomalous mass in the abdomen should arouse suspicion, as should also involvement of the pleura, the apex of one lung, or a testis in the male.

IV. PULMONARY TUBERCULOSIS

(*Phthisis, Consumption*)

Three clinical groups may be conveniently recognized: (1) *tuberculo-pneumonic phthisis*—acute phthisis; (2) *chronic ulcerative phthisis;* and (3) *fibroid phthisis.*

According to the mode of infection there are two distinct types of lesions:

(*a*) When the bacilli reach the lungs through the blood-vessels or lymphatics the primary lesion is usually in the tissues of the alveolar walls, in the capillary vessels, the epithelium of the air-cells, and in the connective-tissue framework of the septa. The irritation of the bacilli produces, within a few days, the small, gray miliary nodules, involving several alveoli and consisting largely of round, cuboidal, uninuclear epithelioid cells. Depending upon the number of bacilli which reach the lung in this way, either a localized or a general tuberculosis is excited. The tubercles may be uniformly scattered through both lungs and form a part of a general miliary tuberculosis, or they may be confined to the lungs, or even in great part to one lung. The changes which the tubercles undergo have already been referred to. The further stages may be: (1) Arrest of the process of cell division, gradual sclerosis of the tubercle, and ultimately complete fibroid transformation. (2) Caseation of the centre of the tubercle, extension at the periphery by proliferation of the epithelioid and lymphoid cells, so that the individual tubercles or small groups become confluent and form diffuse areas which undergo caseation and softening. (3) Occasionally as a result of intense infection of a localized region through the blood-vessels the tubercles are thickly set. The intervening tissue becomes acutely inflamed, the air-cells are filled with the products of a desquamative pneumonia, and many lobules are involved.

(*b*) When the bacilli reach the lung through the bronchi—inhalation or aspiration tuberculosis—the picture differs. The smaller bronchi and bronchioles are more extensively affected; the process is not confined to single groups of alveoli, but has a more lobular arrangement, and the tuberculous masses from the outset are larger, more diffuse, and may in some cases involve

epid. pneum. virida

acuta pneumonia tubere.
chr. ulc.
fibrosis tuberculosa

an entire lobe or the greater part of a lung. It is in this mode of infection that we see the characteristic peri-bronchial granulations and the areas of the so-called nodular broncho-pneumonia. These broncho-pneumonic areas, with on the one hand caseation, ulceration, and cavity formation, and on the other sclerosis and limitation, make up the essential elements in the anatomical picture of ~~tuberculous phthisis~~. pul. tub.

1. *Acute Pneumonic Tuberculosis of the Lungs*

This form, known also by the name of *galloping consumption*, is met with both in children and adults. In the former many of the cases are mistaken for simple broncho-pneumonia.

Two types may be recognized, the *pneumonic* and *broncho-pneumonic*.

The Pneumonic Form.—In the *pneumonic form* one lobe may be involved, or in some instances an entire lung. The organ is heavy, the affected portion airless; the pleura is usually covered with a thin exudate, and on section the picture resembles closely that of ordinary hepatization. The following is an extract from the post mortem report of a case in which death occurred twenty-nine days after the onset of the illness, having all the characters of an acute pneumonia: "Left lung weighs 1,500 grams (double the weight of the other organ) and is heavy and airless, crepitant only at the anterior margins. Section shows a small cavity the size of a walnut at the apex, about which are scattered tubercles in a consolidated tissue. The greater part of the lung presents a grayish-white appearance due to the aggregation of tubercles which in some places have a continuous, uniform appearance, in others are surrounded by an injected and consolidated lung-tissue. Toward the margins of the lower lobe strands of this firm reddish tissue separate anæmic, dry areas. There are in the right lung three or four small groups of tubercles but no caseous masses. The bronchial glands are not tuberculous." Here the intense local infection was due to the small focus at the apex of the lung, probably an aspiration process.

Only the most careful inspection may reveal the presence of miliary tubercles, or the attention may be arrested by the detection of tubercles in the other lung or in the bronchial glands. The process may involve only one lobe. There may be older areas which are of a peculiarly yellowish-white color and distinctly caseous. The most remarkable picture is presented by cases of this kind in which the disease lasts for some months. A lobe or an entire lung may be enlarged, firm, airless throughout, and converted into a dry, yellowish-white, cheesy substance. Cases are met with in which the entire lung from apex to base is in this condition, with perhaps only a small, narrow area of air-containing tissue on the margin. More commonly, if the disease has lasted for two or three months, rapid softening has taken place at the apex with extensive cavity formation.

Males are much more frequently attacked than females. Of my series of 15 cases, 11 were males. The onset was acute in 13, with a chill in 9. Bacilli were found in the sputum in one case as early as the fourth day. Fraenkel and Troje believe that the cases are of bronchogenous origin, due to infection from a small focus somewhere in the lung. ~~They found tubercle bacilli alone in 11 of their 12 cases.~~ Tendeloo, ~~who reports a fatal case on the sixth day,~~ regards the infection as sometimes hæmatogenous.

Symptoms.—The attack sets in abruptly with a chill, usually in an individual who has enjoyed good health, although in many cases the onset has been preceded by exposure to cold, or there have been debilitating circumstances. The temperature rises rapidly after the chill, there are pain in the side and cough, with at first mucoid, subsequently rusty-colored expectoration which may contain tubercle bacilli. The dyspnœa may become extreme and the patient may have suffocative attacks. The physical examination shows involvement of one lobe or of one lung, with signs of consolidation, dulness, increased fremitus, at first feeble or suppressed vesicular murmur, and subsequently well-marked bronchial breathing. The upper or lower lobe may be involved, or in some cases the entire lung.

At this time, as a rule, no suspicion enters the mind of the practitioner that the case is anything but one of frank lobar pneumonia. Occasionally there may be suspicious circumstances in the history of the patient or in his family; but, as a rule, no stress is laid upon them in view of the intense and characteristic mode of onset. Between the eighth and tenth day, instead of the expected crisis, the condition becomes aggravated, the temperature is irregular, and the pulse more rapid. There may be sweating, and the expectoration bcomes muco-purulent and greenish in color—a point of special importance, to which Traube called attention. Even in the second or third week, with the persistence of these symptoms, the physician tries to console himself with the idea that the case is one of unresolved pneumonia, and that all will yet be well. Gradually, however, the severity of the symptoms, the presence of physical signs indicating softening, the existence of elastic tissue and tubercle bacilli in the sputum present the mournful proofs that the case is one of acute pneumonic phthisis. Death may occur on the sixth day, as in a case of Tendeloo's. The earliest death in my series was on the thirteenth day. A majority of the cases drag on, and death does not occur until the third month. In a few cases, even after a stormy onset and active course, the symptoms subside and the patient passes into the chronic stage.

Diagnosis.—Waters, of Liverpool, who gave an admirable description of these cases, called attention to the difficulty in distinguishing them from ordinary pneumonia. Certainly the mode of onset affords no criterion whatever. A healthy, robust-looking young Irishman, a cab-driver, who had been kept waiting on a cold, blustering night until three in the morning, was seized the next afternoon with a violent chill, and the following day was admitted to my wards at the University Hospital, Philadelphia. He was made the subject of a clinical lecture on the fifth day, when there was absent no single feature in history, symptoms, or physical signs of acute lobar pneumonia of the right upper lobe. It was not until ten days later, when bacilli were found in his expectoration, that we were made aware of the true nature of the case. I know of no criterion by which cases of this kind can be distinguished in the early stage. A point to which Traube called attention, and which is also referred to as important by Hérard and Cornil, is the absence of breath-sounds in the consolidated region; but this, I am sure, does not hold good in all cases. The tubular breathing may be intense and marked as early as the fourth day; and again, how common it is to have, as one of the earliest and most suggestive symptoms of lobar pneumonia, suppression or enfeeblement of the vesicular murmur! In many cases, however, there are suspicious circum-

stances in the onset: the patient has been in bad health, or may have had previous pulmonary trouble, or there are recurring chills. Careful examination of the sputum and a study of the physical signs from day to day can alone determine the true nature of the case. In one of my cases the bacilli were found on the fourth day. A point of some moment is the character of the fever, which in true pneumonia is more continuous, particularly in severe cases, whereas in this form of tuberculosis remissions of 1.5° or 2° are not infrequent.

Acute Tuberculous Broncho-pneumonia.—Acute tuberculous broncho-pneumonia is more common, particularly in children, and forms a majority of the cases of *phthisis florida,* or "galloping consumption." It is an acute caseous broncho-pneumonia, starting in the smaller tubes, which become blocked with a cheesy substance, while the air-cells of the lobule are filled with the products of a catarrhal pneumonia. In the early stages the areas have a grayish red, later an opaque white, caseous appearance. By the fusion of contiguous masses an entire lobe may be rendered nearly solid, but areas of crepitant air tissue can usually be seen between the groups. This is not an uncommon picture in the acute phthisis of adults, but it is still more frequent in children. The following is an extract from the post mortem report of a case on a child aged four months, who died in the sixth week of illness: "On section, the right upper lobe is occupied with caseous masses from 5 to 12 mm. in diameter, separated from each other by an intervening tissue of a deep red color. The bronchi are filled with cheesy substance. The middle and lower lobes are studded with tubercles, many of which are becoming caseous. Toward the diaphragmatic surface of the lower lobe there is a small cavity the size of a marble. The left lung is more crepitant and uniformly studded with tubercles of all sizes, some as large as peas. The bronchial glands are very large, and one contains a tuberculous abscess."

There is a form of tuberculous aspiration pneumonia, to which Bäumler has called attention, occurring as a sequence of hæmoptysis, and due to the aspiration of blood and the contents of pulmonary cavities into the finer tubes. There are fever, dyspnœa, and signs of a diffuse broncho-pneumonia. Some of these cases run a very rapid course, (and are examples of galloping consumption following hæmoptysis.) This accident may occur not only early in the disease, but may follow hæmorrhage in a well-marked pulmonary tuberculosis.

In children the enlarged bronchial glands usually surround the root of the lung, and even pass deeply into the substance, and the lobules are often involved by direct contact.

In other cases the caseous broncho-pneumonia involves groups of alveoli or lobules in different portions of the lungs, more commonly at both apices, forming areas from 1 to 3 cm. in diameter. The size of the mass depends largely upon that of the bronchus involved. There are cases which probably should come in this category, in which, with a history of an acute illness of from four to eight weeks, the lungs are extensively studded with large gray tubercles, ranging in size from 5 to 10 mm. In some instances there are cheesy masses the size of a cherry. All of these are grayish-white in color, distinctly cheesy, and between the adjacent ones, particularly in the lower lobe, there may be recent pneumonia, or the condition of lung which has been

termed splenization. In a case of this kind at the Philadelphia Hospital death took place about the eighth week from the abrupt onset of the illness with hæmorrhage. There were no extensive areas of consolidation, but the cheesy nodules were uniformly scattered throughout both lungs. No softening had taken place.

Secondary infections are not uncommon; but Prudden was able to show that the tubercle bacillus could produce not only distinct tubercle nodules, but also the various kinds of exudative pneumonia, the exudates varying in appearance in different cases, which phenomena occurred absolutely without the intervention of other organisms. The fact that these latter had not subsequently crept in was shown by cultures at the autopsy on the affected animal.

Symptoms.—The symptoms of acute broncho-pneumonic phthisis are very variable. In adults the disease may attack persons in good health, but overworked or "run down" from any cause. Hæmorrhage initiates the attack in a few cases. There may be repeated chills; the temperature is high, the pulse rapid, and the respirations are increased. The loss of flesh and strength is very striking.

The physical signs may at first be uncertain and indefinite, but finally there are areas of impaired resonance, usually at the apices; the breath sounds are harsh and tubular, with numerous râles. The sputum may early show elastic tissue and tubercle bacilli. In the acute cases, within three weeks, the patient may be in a marked typhoid state, with delirium, dry tongue, and high fever. Death may occur within three weeks. In other cases the onset is severe, with high fever, rapid loss of flesh and strength, and signs of extensive unilateral or bilateral disease. Softening takes place; there are sweats, chills, and progressive emaciation, and all the features of *phthisis florida*. Six or eight weeks later the patient may begin to improve, the fever lessens, the general symptoms abate, and a case which looked as if it would ~~certainly~~ terminate fatally within a few weeks drags on and becomes chronic.

In *children* the disease most commonly follows the infectious diseases, particularly measles and whooping cough. At least *three groups* of these tuberculous broncho-pneumonias may be recognized. In the *first* the child is taken ill suddenly while teething or during convalescence from fever; the temperature rises rapidly, the cough is severe, and there may be signs of consolidation at one or both apices with râles. Death may occur within a few days, and the lung shows areas of broncho-pneumonia, with perhaps here and there scattered opaque grayish-yellow nodules. Macroscopically the affection does not look tuberculous, but histologically miliary granulations and bacilli may be found. Tubercles are usually present in the bronchial glands, but the appearance of the broncho-pneumonia may be exceedingly deceptive, and it may require careful microscopic examination to determine its tuberculous character. The *second group* is represented by the case of the child previously quoted, who died at the sixth week with the ordinary symptoms of severe broncho-pneumonia. And the *third group* is that in which, during the convalescence from an infectious disease, the child is taken ill with fever, cough, and shortness of breath. The severity of the symptoms abates within the first fortnight; but there is loss of flesh, the general condition is bad, and the physical examination shows the presence of scattered râles throughout the

lungs, and here and there areas of defective resonance. The child has sweats, the fever becomes hectic in character, and in many cases the clinical picture gradually passes into that of chronic phthisis.

2. *Chronic Ulcerative Tuberculosis of the Lungs*

Under this heading may be grouped the great majority of cases of pulmonary tuberculosis, in which the lesions proceed to ulceration and softening, and ultimately produce the well-known picture of chronic phthisis.

Morbid Anatomy.—Inspection of the lungs shows a remarkable variety of lesions, comprising nodular tubercles, diffuse tuberculous infiltration, caseous masses, pneumonic areas, cavities of various sizes, with changes in the pleura, bronchi, and bronchial glands.

The Distribution of the Lesions.—For years it has been recognized that the most advanced lesions are at the apices, and that the disease progresses downward, usually more rapidly in one of the lungs. This general statement, which has passed current in the text-books ever since the masterly description of Laennec, has been carefully elaborated by Kingston Fowler, who finds that the disease in its onward progress through the lungs follows, in a majority of the cases, distinct routes. In the upper lobe the primary lesion is not, as a rule, at the extreme apex, but from an inch to an inch and a half below the summit of the lung, and nearer to the posterior and external borders. The lesion here tends to spread downward, probably from inhalation of the virus, and this accounts for the frequent circumstance that examination behind, in the supra-spinous fossa, will give indications of disease before any evidences exist at the apex in front. Anteriorly this initial focus corresponds to a spot just below the centre of the clavicle, and the direction of extension in front is along the anterior aspect of the upper lobe, along a line running about an inch and a half from the inner ends of the first, second, and third interspaces. A second less common site of the primary lesion in the apex "corresponds on the chest wall with the first and second interspaces below the outer third of the clavicle." The extension is downward, so that the outer part of the upper lobe is chiefly involved.

In the middle lobe of the right lung the affection usually follows disease of the upper lobe on the same side. In the involvement of the lower lobe the first secondary infiltration is about an inch to an inch and a half below the posterior extremity of its apex, and corresponds on the chest wall to a spot opposite the fifth dorsal spine. This involvement is of the greatest importance clinically, as "in the great majority of cases, when the physical signs of the disease at the apex are sufficiently definite to allow of the diagnosis of phthisis being made, the lower lobe is already affected." Examination, therefore, should be made carefully of this posterior apex in all suspicious cases. In this situation the lesion spreads downward and laterally along the line of the interlobular septa, a line which is marked by the vertebral border of the scapula, when the hand is placed on the opposite scapula and the elbow raised above the level of the shoulder. Once present in an apex, the disease usually extends in time to the opposite upper lobe; but not, as a rule, until the apex of the lower lobe of the lung first affected has been attacked.

Of 427 cases, ~~above mentioned,~~ the right apex was involved in 172, the left in 130, both in 111.

Lesions of the base may be primary, though this is rare. Percy Kidd makes the proportion of basic to apical phthisis 1 to 500, a smaller number than existed in my series. In very chronic cases there may be arrested lesions at the apex and more recent lesions at the base.

Summary of the Lesions in Chronic Ulcerative Phthisis.—(*a*) *Miliary Tubercles.*—They have one of two distributions: (1) A dissemination due to aspiration of tuberculous material, the tubercles being situated in the air-cells or the walls of the smaller bronchi; (2) the distribution due to dissemination of tubercle bacilli by the lymph current, the tubercles being scattered about the old foci in a radial manner—the secondary crop of Laennec. Much more rarely there is a scattered dissemination from infection here and there of the smaller vessels, the tubercles then being situated in the vessel walls. Sometimes, in cases with cavity formation at the apex, the greater part of the lower lobes presents many groups of firm, sclerotic, miliary tubercles, which may indeed form the distinguishing anatomical feature—a chronic miliary tuberculosis.

(*b*) *Tuberculous Broncho-pneumonia.*—In a large proportion of the cases of chronic ~~phthisis~~ the terminal bronchiole is the point of origin of the process, consequently we find the smaller bronchi and their alveolar territories blocked with the accumulated products of inflammation in all stages of *caseation.* At an early period a cross-section of an area of tuberculous broncho-pneumonia gives the most characteristic appearance. The central bronchiole is seen as a small orifice, or it is plugged with cheesy contents, while surrounding it is a caseous nodule, the so-called peribronchial tubercle. The longitudinal section has a somewhat dendritic or foliaceous appearance. The condition of the picture depends much upon the slowness or rapidity with which the process has advanced. The following changes may occur:

Ulceration.—When the caseation takes place rapidly or ulceration occurs in the bronchial wall, the mass may break down and form a small cavity.

Sclerosis.—In other instances the process is more chronic, and fibroid changes gradually produce a sclerosis of the affected area. This ~~sclerosis~~ may be confined to the margin of the mass, forming a limiting capsule, within which is a uniform, firm, cheesy substance, in which lime salts are often deposited. This represents the healing of one of these areas of caseous broncho-pneumonia. It is only, however, when complete fibroid transformation or calcification has occurred that we can really speak of healing. In many instances the colonies of miliary tubercles about these masses show that the virus is still active in them. Subsequently, in ulcerative processes, these calcareous bodies—lung-stones, as they are sometimes called—may be expectorated.

(*c*) *Pneumonia.*—An important though secondary place is occupied by inflammation of the alveoli surrounding the tubercles, which become filled with epithelioid cells. The consolidation may extend for some distance about the tuberculous foci and unite them into areas of uniform consolidation. Although in some instances this inflammatory process may be simple, in others it is undoubtedly specific. It is excited by the tubercle bacilli and is a manifestation of their action. It may present a very varied appearance; in

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some instances resembling closely ordinary red hepatization, in others being more homogeneous and infiltrated, the so-called *infiltration tuberculeuse* of Laennec. In other cases the contents of the alveoli undergo fatty degeneration, and appear on the cut surface as opaque white or yellowish-white bodies. In early phthisis much of the consolidation is due to this pneumonic infiltration, which may surround for some distance the smaller tubercular foci.

(*d*) *Cavities.*—A vomica is a cavity in the lung tissue, produced by necrosis and ulceration. The process usually begins in the wall of the bronchus in a tuberculous area. Dilatation is produced by retained secretion, and necrosis and ulceration of the wall occur with gradual destruction of the contiguous tissues. By extension of the necrosis and ulceration the cavity increases, contiguous ones unite, and in an affected region there may be a series of small excavations communicating with a bronchus. In nearly all instances the process extends from the bronchi, though it is possible for necrosis and softening to take place in the centre of a caseous area without primary involvement of the bronchial wall. Three forms of cavities may be recognized.

The *fresh ulcerative,* seen in acute phthisis, in which there is no limiting membrane, but the walls are made up of softened, necrotic, and caseous masses. A small vomica of this sort, situated just beneath the pleura, may rupture and cause pneumothorax. In cases of acute tuberculo-pneumonic phthisis they may be large, occupying the greater portion of the upper lobe. In the chronic ulcerative phthisis cavities of this sort are invariably present in those portions of the lung in which the disease is advancing. At the apex there may be a large old cavity with well-defined walls, while at the anterior margin of the upper lobes, or in the apices of the lower lobes, there are recent ulcerating cavities communicating with the bronchi.

Cavities with well-defined Walls.—A majority of the cavities in the chronic form of phthisis have a well-defined limiting membrane, the inner surface of which constantly produces pus. The walls are crossed by trabeculæ which represent remnants of bronchi and blood-vessels. Even the cavities with the well-defined walls extend gradually by a slow necrosis and destruction of the contiguous lung tissue. The contents are usually purulent, similar in character to the grayish nummular sputa coughed up. Not infrequently the membrane is vascular or it may be hæmorrhagic. Occasionally, when gangrene has occurred in the wall, the contents are horribly fetid. These cavities may occupy the greater portion of the apex, forming an irregular series which communicate with each other and with the bronchi, or the entire upper lobe except the anterior margin may be excavated, forming a thin-walled cavity. In rare instances the process has proceeded to total excavation of the lung, not a remnant of which remains, except perhaps a narrow strip at the anterior margin. In a case of this kind, in a young girl, the cavity held 40 fluid ounces, in another 42 ounces.

Quiescent Cavities.—When quite small and surrounded by dense cicatricial tissue communicating with the bronchi they form the *cicatrices fistuleuses* of Laennec. Occasionally one apex may be represented by a series of these small cavities, surrounded by dense fibrous tissue. The lining membrane of these old cavities may be quite smooth, almost like a mucous membrane. Cavities of any size do not heal completely.

Cases are often seen in which it has been supposed that a cavity has healed; but the signs of excavation are notoriously uncertain, and there may be pectoriloquy and cavernous sounds with gurgling resonant râles in an area of consolidation close to a large bronchus.

In the formation of cavities the blood vessels gradually become closed by an obliterating inflammation. They are the last structures to yield and may be completely exposed in a cavity, even when the circulation is still going on in them. Unfortunately, the erosion of a large vessel which has not yet been obliterated is by no means infrequent, and causes profuse and often fatal hæmorrhage. Another common event is the formation of aneurisms on the arteries running in the walls of cavities. These may be small, bunch-like dilatations, or they may form sacs the size of a walnut or even larger. Rasmussen, Douglas Powell, and others have called attention to their importance in hæmoptysis, under which section they are dealt with more fully.

And, finally, about cavities of all sorts, the connective tissue grows, tending to limit their extent. The thickening is particularly marked beneath the pleura, and in chronic cases an entire apex may be converted into a mass of fibrous tissue, inclosing a few small cavities.

(*e*) *Pleura.*—Practically, in all cases of chronic phthisis the pleura is involved. Adhesions take place which may be thin and readily torn, or dense and firm, uniting layers of from 2 to 5 mm. in thickness. This pleurisy may be simple, but in many cases it is tuberculous, and miliary tubercles or caseous masses are seen in the thickened membrane. Effusion is not at all infrequent, either serous, purulent, or hæmorrhagic. Pneumothorax is a common accident.

(*f*) Changes in the *smaller bronchi* control the situation in the early stages of tuberculous phthisis, and play an important rôle throughout the disease. The process very often begins in the walls of the smaller tubes and leads to caseation, distention with products of inflammation, and broncho-pneumonia of the lobules. In many cases the visible implication of the bronchus is an extension upward of a process which has begun in the smallest bronchiole. This involvement weakens the wall, leading to bronchiectasis, not an uncommon event. The mucous membrane of the larger bronchi, which is usually involved in a chronic catarrh, is more or less swollen, and in some instances ulcerated. Besides these specific lesions, they may be the seat, especially in children, of inflammation due to secondary invasion, most frequently by the *Micrococcus lanceolatus*, with the production of a broncho-pneumonia.

(*g*) The *bronchial glands*, in the more acute cases, are swollen and œdematous. Miliary tubercles and caseous foci are usually present. In cases of chronic tuberculosis the caseous areas are common, calcification may occur, and not infrequently purulent softening.

(*h*) *Changes in the Other Organs.*—Of these, tuberculosis is the most common. In my series of autopsies the brain presented tuberculous lesions in 31, the spleen in 33, the liver in 12, the kidneys in 32, the intestines in 65, and the pericardium in 7. Other groups of lymphatic glands besides the bronchial may be affected.

Amyloid change may occur in the liver, spleen, kidneys, and mucous membrane of the intestines. The *liver* is often the seat of extensive fatty infiltration, which may cause marked enlargement. The *intestinal tuberculosis*

tub.

Branchial appendages reduced. Right pair may give darkness in vi brāsch. reg.
Whispering branchiostegus sin vi brāsch. reg
emph.

occurs in advanced cases and is responsible in great part for the troublesome diarrhœa.

Endocarditis is not very common, and was present in 12 of my post mortems and in 27 of Percy Kidd's 500 cases. Tubercle bacilli have been found in the vegetations. Tubercles may be present on the endocardium, particularly of the right ventricle.

The *larynx* is frequently involved, and ulceration of the vocal cords and destruction of the epiglottis are not at all uncommon.

Modes of Onset.—We have already seen that tuberculosis of the lungs may occur as the chief part of a general infection, or may set in with symptoms which closely simulate acute pneumonia. In the ordinary type of pulmonary tuberculosis the invasion is gradual and less striking, but presents an extraordinarily diverse picture, so that the practitioner is often led into error. Among the most characteristic modes of onset are the following:

(*a*) Latent Types.—It is probable that many slight, ill-defined ailments are due to a local unrecognized tuberculosis of the lung. In the history of patients with tuberculosis such attacks are not infrequently mentioned.

The disease makes considerable progress before there are serious symptoms to arouse the attention of the patient. In workingmen the disease may even advance to excavation of an apex before they seek advice. It is not a little remarkable how slight the lung symptoms may have been.

The symptoms may be masked by the existence of serious disease in other organs, as in the peritoneum, intestines, or bones.

(*b*) With Symptoms of Dyspepsia and Anæmia.—The gastric mode of onset is very common, and the early manifestations may be great irritability of the stomach with vomiting or a type of acid dyspepsia with eructations. In young girls (and in children) with this dyspepsia there is very frequently a pronounced chloro-anæmia, and the patient complains of palpitation of the heart, increasing weakness, slight afternoon fever, and amenorrhœa.

(*c*) Malarial Symptoms.—In a considerable number of cases the onset of pulmonary tuberculosis is with symptoms which suggest malarial fever. The patient has repeated paroxysms of chills, fevers, and sweats, which may recur with great regularity. In districts in which malaria prevails there is no more common mistake than to confound the initial rigors of pulmonary tuberculosis with it.

(*d*) Onset with Pleurisy.—The first symptoms may be a dry pleurisy over an apex, with persistent friction murmur. In other instances the pulmonary symptoms have followed an attack of pleurisy with effusion. The exudate gradually disappears, but the cough persists and the patient becomes feverish, and gradually signs of disease at one apex become manifest. About one-third of all cases of pleurisy with effusion subsequently have pulmonary tuberculosis.

(*e*) With Laryngeal Symptoms.—The primary localization may be in the larynx, though in a majority of the instances in which huskiness and laryngeal symptoms are the first noticeable features of the disease there are doubtless foci already existing in the lung. The group of cases in which for many months throat and larynx symptoms precede the manifestations of pulmonary tuberculosis is a very important one.

(*f*) Onset with Hæmoptysis.—Frequently the very first symptom is

a brisk hæmorrhage from the lungs, following which the pulmonary symptoms may come on with great rapidity. In other cases the hæmoptysis recurs, and it may be months before the symptoms become well established. In a majority of these cases the local tuberculous lesion exists at the date of the hæmoptysis.

(*g*) With Tuberculosis of the Cervico-axillary Glands.—Preceding the onset of pulmonary disease for months, or even for years, the lymph-glands of the neck or of the neck and axilla of one side may be enlarged. These cases are by no means infrequent, and they are of importance because of the latency of the pulmonary lesions. Nowadays, when operative interference is so common, it is well to bear in mind that in such patients the corresponding apex of the lung may be extensively involved.

(*h*) Bronchial Symptoms.—And, lastly, in by far the largest number of all cases the onset is with a *bronchitis,* or, as the patient expresses it, a neglected cold. There has been, perhaps, a liability to catch cold easily or the patient has been subject to naso-pharyngeal catarrh; then, following some unusual exposure, a cough begins, which may be frequent and ~~very~~ irritating. The examination of the lungs may reveal localized ~~moist sounds~~ at one apex and perhaps wheezing bronchitic râles in other parts. In a few cases the early symptoms are ~~often~~ suggestive of asthma with marked wheezing and diffuse piping râles.

Symptoms.—In discussing the symptoms it is usual to divide the disease into three periods: the first embracing the time of the growth and development of the tubercles; the second, when they soften; and the third, when there is a formation of cavities. Unfortunately, these anatomical stages can not be satisfactorily correlated with corresponding clinical periods, and we often find that a patient in the third stage with a well-marked cavity is in a far better condition and has greater prospects of recovery than a patient in the first stage with diffuse consolidation. It is therefore better perhaps to disregard them altogether.

Local Symptoms.—*Pain* in the chest may be early and troublesome or absent throughout. It is usually associated with pleurisy, and may be sharp and stabbing in character, and either constant or felt only during coughing. Perhaps the commonest situation is in the lower thoracic zone, though in some instances it is beneath the scapula or referred to the apex. The attacks may recur at long intervals. Intercostal neuralgia occasionally occurs in the course of ordinary pulmonary tuberculosis.

Cough is one of the earliest symptoms, and is present in the majority of cases from beginning to end. There is nothing peculiar or distinctive about it. At first dry and hacking, and perhaps scarcely exciting the attention of the patient, it subsequently becomes looser, more constant, and associated with a glairy, muco-purulent expectoration. In the early stages of the disease the cough is bronchial in its origin. When cavities have formed it becomes more paroxysmal, and is most marked in the morning or after a sleep. Cough is not a constant symptom, however, and a patient may present himself with well-marked excavation at one apex who will declare that he has had little or no cough. So, too, there may be well-marked physical signs, dulness and moist sounds, without either expectoration or cough. In well-established cases the nocturnal paroxysms are most distressing and prevent sleep. The cough may be of such persistence and severity as to cause vomiting, and the

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patient becomes rapidly emaciated from loss of food—Morton's cough (Phthisiologia, 1689, p. 101). The laryngeal complications give a peculiarly husky quality to the cough, and when erosion and ulceration have proceeded far in the vocal cords the coughing becomes much less effective.

Sputum.—This varies greatly in amount and character with the different stages. There are patients with well-marked local signs at one apex, with slight cough and moderately high fever, without from day to day a trace of expectoration. So, also, there are instances with the most extensive consolidation (caseous pneumonia) and high fever, but without enough expectoration to enable an examination for bacilli to be made. In the early stage of pulmonary tuberculosis the sputum is chiefly catarrhal and has a glairy, sago-like appearance, due to the presence of alveolar cells which have undergone the myeline degeneration. There is nothing distinctive or peculiar in this form of expectoration, which may persist for months without indicating serious trouble. The earliest trace of characteristic sputum may show the presence of small grayish or greenish-gray purulent masses. These, when coughed up, are always suggestive and should be the portions picked out for microscopic examination. As softening comes on, the expectoration becomes more profuse and purulent, but may still contain a considerable quantity of alveolar epithelium. Finally, when cavities exist, the sputum assumes the so-called nummular form; each mass is isolated, flattened, greenish-gray in color, quite airless, and, when spat into water, sinks to the bottom.

By the microscopic examination of the sputum we determine whether the process is tuberculous, and whether softening has occurred. The bacilli in stained preparations are seen as elongated, slightly curved, red rods, sometimes presenting a beaded appearance. They are frequently in groups of three or four, but the number varies considerably. Only one or two may be found in a preparation, or, in some instances, they are so abundant that the entire field is occupied. Repeated examinations may be necessary.

The continued presence of tubercle bacilli in the sputum is an infallible indication of the existence of tuberculosis.

One or two may possibly be due to accidental inhalation. A number may come from a spot of softening 3 by 3 cm. In the nummular sputa of later stages the bacilli are very abundant.

Elastic tissue may be derived from the bronchi, the alveoli, or from the arterial coats; and naturally the appearance of the tissue will vary with the locality from which it comes. In the examination for this it is not necessary to boil the sputum with caustic potash. For years I have used a simple plan which was shown to me at the London Hospital by Sir Andrew Clark. This method depends upon the fact that in almost all instances if the sputum is spread in a sufficiently thin layer the fragments of elastic tissue can be seen with the naked eye. The thick, purulent portions are placed upon a glass plate 15×15 cm. and flattened into a thin layer by a second glass plate 10×10 cm. In this compressed grayish layer between the glass slips any fragments of elastic tissue show on a black background as grayish-yellow spots and can either be examined at once under a low power or the uppermost piece of glass is slid along until the fragment is exposed, when it is picked out and placed upon the ordinary microscopic slide. Fragments of bread and collections of milk-globules may also present an opaque white appearance,

but with a little practice they can readily be recognized. Fragments of epithelium from the tongue, infiltrated with micrococci, are still more deceptive, but the miscroscope at once shows the difference.

The bronchial elastic tissue forms an elongated network, or two or three long, narrow fibres are found close together. From the blood-vessels a somewhat similar form may be seen and occasionally a distinct sheeting is found as if it had come from the intima of a good-sized artery. The elastic tissue of the alveolar wall is quite distinctive; the fibres are branched and often show the outline of the arrangement of the air-cells. The elastic tissue from bronchi or alveoli indicates extensive erosion of a tube and softening of the lung-tissue.

Another occasional constituent of the sputum is blood, which may be present as the chief characteristic of the expectoration in hæmoptysis or may simply tinge the sputum. In chronic cases with large cavities, in addition to bacteria, various forms of fungi may be found, of which the aspergillus is the most important. Sarcinæ may also occur.

Calcareous Fragments.—Formerly a good deal of stress was laid upon their presence in the sputum, and Morton described a phthisis *a calculis in pulmonibus generatis.* Bayle also described a separate form of *phthisis calculeuse.* The size of the fragments varies from a small pea to a large cherry. As a rule, a single one is ejected; sometimes large numbers are coughed up in the course of the disease. They are formed in the lung by the calcification of caseous masses, and it is said also occasionally in obstructed bronchi. They may come from the bronchial glands by ulceration into the bronchi, and there is a case on record of suffocation in a child from this cause.

The daily amount of expectoration varies. In rapidly advancing cases, with much cough, it may reach as high as 500 c. c. in the day. In cases with large cavities the chief amount is brought up in the morning. The expectoration of tuberculous patients usually has a heavy, sweetish odor, and occasionally it is fetid, owing to decomposition in the cavities.

Hæmoptysis.—One of the most famous of the Hippocratic axioms says, "From a spitting of blood there is a spitting of pus." The older writers thought that the phthisis was directly due to the inflammatory or putrefactive changes caused by the hæmorrhage into the lung. Morton, however, in his interesting section, *Phthisis ab Hæmoptöe,* rather doubted this sequence. Laennec and Louis, and later in the century Traube, regarded the hæmoptysis as an evidence of existing disease of the lung. From the accurate views of Laennec and Louis the profession was led away by Graves, and particularly by Niemeyer, who held that the blood in the air-cells set up an inflammatory process, a common termination of which was caseation. Since Koch's discovery we have learned that many cases in which the physical examination is negative show, either during the period of hæmorrhage or immediately after it, tubercle bacilli in the sputum, so that opinion has veered to the older view, and we now regard the appearance of hæmoptysis as an indication of existing disease. In young, apparently healthy, persons cases of hæmoptysis may be divided into three groups. In the first the bleeding has come on without premonition, without overexertion or injury, and there is no family history of tuberculosis. The physical examination is negative, and the examination of the expectoration at the time of the hæmorrhage and subsequently shows no

tubercle bacilli. Such instances are not uncommon, and, though one may suspect strongly the presence of some focus of tuberculosis, yet the individuals may retain good health for many years, and have no further trouble. Of the 386 cases of hæmoptysis noted by Ware in private practice 62 recovered, and pulmonary disease did not subsequently occur.

In a second group individuals in apparently perfect health are suddenly attacked, perhaps after a slight exertion or during some athletic exercises. The physical examination is also negative, but tubercle bacilli are found sometimes in the bloody sputum, more frequently a few days later.

In a third set of cases the individuals have been in failing health for a month or two, but the symptoms have not been urgent and perhaps not noticed by the patients. The physical examination shows the presence of well-marked tuberculous disease, and there are both tubercle bacilli and elastic tissue in the sputum.

A very interesting systematic study of the subject of hæmoptysis, particularly in its relation to the question of tuberculosis, has been completed in the Prussian army by Franz Stricker. During the five years 1890-'95 there were 900 cases admitted to the hospitals, which is a percentage of 0.045 of the strength (1,728,505). Of the cases, in 480 the hæmorrhage came on without recognizable cause. Of these, 417 cases, 86 per cent., were certainly or probably tuberculous. In only 221, however, was the evidence conclusive.

In a second group of 213 cases the hæmorrhage came on during the military exercise, and of these 75 patients were shown to be tuberculous.

In 118 cases the hæmorrhage followed certain special exercises, as in the gymnasium or in riding or in consequence of swimming. In 24 cases it occurred during the exercise of the voice in singing or in giving command or in the use of wind instruments. A very interesting group of 24 cases is reported in which the hæmorrhage followed trauma, either a fall or a blow upon the thorax. In 7 of these tuberculosis was positively present, and in 6 other cases there was a strong probability of its existence.

Among the conclusions which Stricker draws the following are the most important: namely, that soldiers attacked with hæmoptysis without special cause are in at least 86.8 per cent. tuberculous. In the cases in which the hæmoptysis follows the special exercises, etc., of military service at least 74.4 per cent. are tuberculous. In the cases which come on during swimming or as a consequence of direct injury to the thorax about one-half are not associated with tuberculosis.

Hæmoptysis occurs in from 60 to 80 per cent. of all cases of pulmonary tuberculosis. It is more frequent in males than in females.

In a majority of all cases the bleeding recurs. Sometimes it is a special feature throughout the disease, so that a hæmorrhagic form has been recognized. The amount of blood brought up varies from a couple of drachms to a pint or more. In 69 per cent. of 4,125 cases of hæmoptysis at the Brompton Hospital the amount brought up was under half an ounce.

A distinction may be drawn between the hæmoptysis early in the disease and that which occurs in the later periods. In the former the bleeding is usually slight, is apt to recur, and fatal hæmorrhage is very rare. In these cases the bleeding is usually from small areas of softening or from early erosions in the bronchial mucosa. In the later periods, after cavities have

formed, the bleeding, is, as a rule, more profuse and is more apt to be fatal. Single large hæmorrhages, proving quickly fatal, are very rare, except in the advanced stages of the disease. In these cases the bleeding comes either from an erosion of a good-sized vessel in the wall of a cavity or from the rupture of an aneurism of the pulmonary artery.

The bleeding, as a rule, sets in suddenly. Without any warning the patient may notice a warm salt taste and the mouth fills with blood. It may come up with a slight cough. The total amount may not be more than a few drachms, and for a day or two the patient may spit up small quantities. When a large vessel is eroded or an aneurism bursts, the amount of blood brought up is large, and in the course of a short time a pint or two may be expectorated. Fatal hæmorrhage may occur into a very large cavity without any blood being coughed up. The character of the blood is, as a rule, distinctive. It is frothy, mixed with mucus, generally bright red in color, except when large amounts are expectorated, and then it may be dark. The sputum may remain blood-tinged for some days, or there are brownish-black streaks in it, or friable nodules consisting entirely of blood-corpuscles may be coughed up. Blood moulds of the smaller bronchi are sometimes expectorated.

The microscopic examination of the sputum in hæmorrhage cases is most important. If carefully spread out, there may be noted, even in an apparently pure hæmorrhagic mass, little portions of mucus from which bacilli or elastic tissue may be obtained. Flick and others have called attention to the frequency with which hæmoptysis is associated with the appearance or an increase of pneumococci and influenza bacilli in the sputum.

Dyspnœa is not a common accompaniment of ordinary tuberculosis. The greater part of one lung may be diseased and local trouble exist at the other apex without any shortness of breath. Even in the paroxysms of very high fever the respirations may not be much increased. Dyspnœa occurs (*a*) with the rapid extension in both lungs of a broncho-pneumonia; (*b*) with the occurrence of miliary tuberculosis; (*c*) sometimes with pneumothorax; (*d*) in old cases with much emphysema, and it may be associated with cyanosis; (*e*) and, lastly, in long-standing cases, with contracted apices or great thickening of the pleura, the right heart is enlarged, and the dyspnœa may be cardiac.

General Symptoms.—*Fever.*—It is well to bear in mind that the temperature varies slightly in normal individuals, and the afternoon range may be 90°, 99.5° or even 100° F. The difference between the mouth and rectal temperature may be a full degree, and in young full-blooded persons, in the nervous, and after exercise the normal rectal temperature may be 100.5° or even 101° F. To get a correct idea of the temperature range in pulmonary tuberculosis it is necessary to make observations every two hours at first. The usual 8 A. M. and 8 P. M. record is, in a majority of the cases, very deceptive, giving neither the minimum nor maximum. The former usually occurs between 2 and 6 A. M., and the latter between 2 and 6 P. M.

Fever, one of the earliest and most important symptoms, is due to the effect on the heat centres of the toxins or materials absorbed from the tuberculous focus. Later in the disease the hectic fever is caused in part by the absorption of the bacterial products of other organisms. From a small spot of disease not a sufficient amount of toxin may be produced to disturb the

body metabolism, but in the lymph glands, lungs, and bones, from progressing areas of infection sufficient absorption takes place to cause fever. It is an auto-inoculation comparable with the fever produced by an injection of tuberculin. Anything that stimulates the local lymph and blood flow favors the discharge of the toxins and causes fever. A patient at rest may be afebrile; after exercise the temperature may be 102.5°, due to an auto-inoculation. In acute cases the fever is more or less continuous, resembling that of typhoid fever or pneumonia, with slight morning remissions. It may set in with a chill and be followed by sweats, and there are cases with a marked intermittent pyrexia from the onset. As a rule, the degree of activity of the local process may be gauged by the persistency and the range of the fever; and favorable cases are those in which the temperature yields rapidly to rest. In a few cases progress of the local disease continues and may even be rapid without fever. The temperature of consumptives is easily influenced by trivial causes which would not affect a normal person, such as mental excitement, exercise, constipation, etc. The patient is usually aware when fever is present and feels more comfortable with a temperature of 101°. Except the sweating, there are rarely any unpleasant feelings connected with it.

With breaking down of the lung-tissue and formation of cavities, associated as these processes always are with suppuration and mixed infection, the fever assumes a characteristically intermittent or hectic type. For a large part of the day the patient is not only afebrile, but the temperature is subnormal. In the annexed two-hourly chart, from a case of chronic tuberculosis of the lungs, it will be seen that, from 10 P. M. to 8 A. M. or noon, the temperature continuously fell and went as low as 95°. A slow rise then took place through the late morning and early afternoon hours and reached its maximum between 6 and 10 P. M. As shown in the chart, there were in the three days about forty-three hours of pyrexia and twenty-nine hours of apyrexia. The rapid fall of the temperature in the early morning hours is usually associated with sweating. This hectic, as it is called, which is a typical fever of septic infection, is met with when the process of cavity formation and softening is advanced and extending.

Sweating—Drenching perspirations are common in phthisis and constitute one of the most distressing features of the disease. They occur usually with the drop in the fever in the early morning hours, or at any time in the day when the patient sleeps. They may come on early in the disease, but are more persistent and frequent after cavities have formed. Some patients escape altogether.

The *pulse* is increased in frequency and usually in proportion to the height of the fever. Even when at rest and afebrile the pulse may be rapid, but the excitement of counting it may increase the rate 20 to 30 beats. The pulse is often remarkably full, soft and compressible; even after recovery it may remain rapid. Pulsation may sometimes be seen in the capillaries and in the veins on the back of the hand.

Emaciation is a pronounced feature, from which the two common names of the disease have been derived. The loss of weight is gradual and, if the disease is extending, progressive. The scales give one of the best indications of the progress of the patient. It is most rapid early in the disease, when the patient may lose at the rate of five or six pounds a week; and usually is in

direct relation to the intensity and duration of the fever. With the arrest of the progress and the fall in temperature the patient usually begins to regain weight. The average gain in weight of 901 patients at the Adirondack Sanatorium was fourteen pounds (L. Brown). A gain of two pounds a week is satisfactory. Loss of strength may be out of proportion to and quite independent of loss of weight. Early debility may be a marked feature.

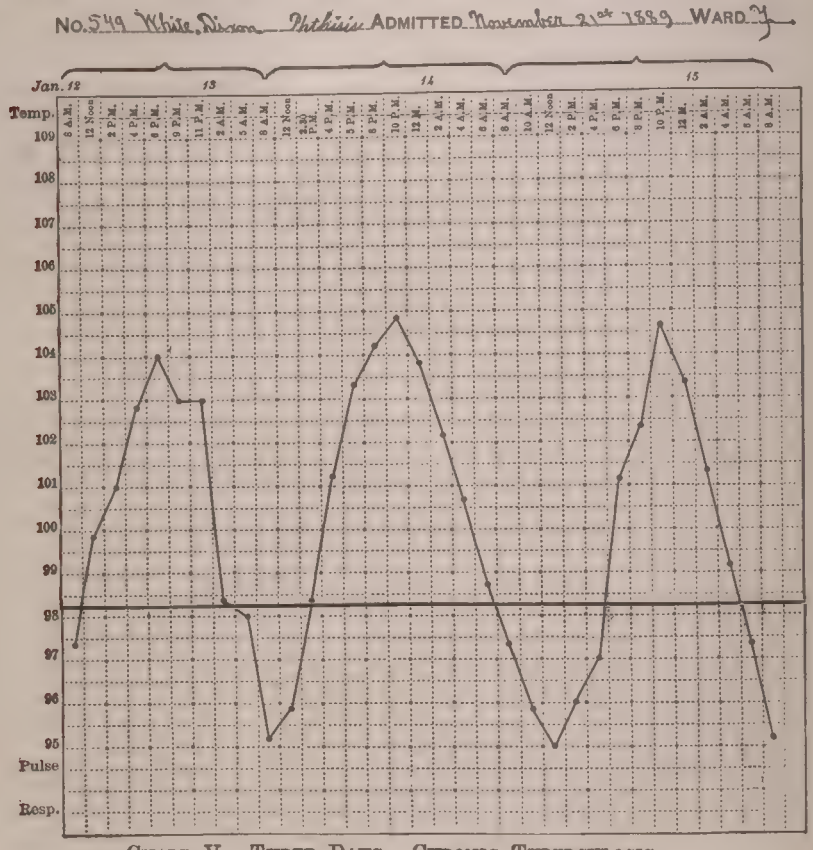

CHART V.—THREE DAYS. CHRONIC TUBERCULOSIS.

PHYSICAL SIGNS.—(*a*) *Inspection.*—The shape of the chest is often suggestive, though it is to be remembered that the disease may be met with in chests of any build. Practically, however, in a considerable proportion of cases the thorax is long and narrow, with very wide intercostal spaces, the ribs more vertical in direction, and the costal angle very narrow. The scapulæ are "winged," a point noted by Hippocrates. Another type of chest which is very common is that which is flattened in the antero-posterior diameter. The costal cartilages may be prominent and the sternum depressed. Occasionally the lower sternum forms a deep concavity, the so-called funnel breast (*Trichter-Brust*). Special examination should be made of the clavicular regions to see if one clavicle stands out more distinctly than the other, or if the spaces above or below it are more marked. Defective expansion at one apex is an early and important sign. The condition of expansion of the

lower zone of the thorax may be well estimated by inspection. The condition of the præcordia should also be noted, as a wide area of impulse, particularly in the second, third, and fourth interspaces, often results from disease of the left apex. From a point behind the patient, looking over the shoulders, one can often better estimate the relative expansion of the apices. Atrophy of the muscles of the shoulder-girdle on the affected side is not uncommon, and a slight scoliosis may be present. Movement may be restricted on the affected side, particularly at the apex. Pleurisy with adhesions or with effusion, fibrosis, and pneumonic consolidation may limit the movement of one side. The Litten phenomenon (seen best on the right side) may be restricted in extent or absent. The chest expansion may be much reduced. It should be recorded carefully at the first examination.

(*b*) *Palpation.*—Deficiency in expansion at the apices or bases is perhaps best gauged by placing the hands in the subclavicular spaces and then in the lateral regions of the chest and asking the patient to draw slowly a full breath. Standing behind the patient and placing the thumbs in the supraclavicular and the fingers in the infraclavicular spaces one can judge accurately as to the relative mobility of the two sides. Disease at an apex, though early and before dulness is at all marked, may be indicated by deficient expansion. On asking the patient to count, the tactile fremitus is increased wherever there is local growth of tubercle or extensive caseation. In comparing the apices it is important to bear in mind that normally the fremitus is stronger over the right than the left. So, too, at the base, when there is consolidation of the lung, the fremitus is increased; whereas, if there is pleural effusion, it is diminished or absent. In the later stages, when cavities form, the tactile fremitus is usually much exaggerated over them. When the pleura is greatly thickened the fremitus may be diminished.

(*c*) *Percussion.*—Tubercles, inflammatory products, fibroid changes, and cavities produce important changes in the pulmonary resonance. There may be localized disease, even of some extent, without inducing much alteration, as when the tubercles are scattered there is air-containing tissue between them. In incipient cases percussion may be negative, 28 out of 201 in L. Brown's series. It requires a fair-sized area of infiltration to cause a change in the percussion note, 4 x 6 cm., according to Cornet. The personal equation is very important in estimating the early physical signs in pulmonary tuberculosis, and I remember a notable diagnosis of a cavity at the back of the left apex the size of a hickory nut, *with the shell on!* One of the earliest and most valuable signs is defective resonance upon and above a clavicle. In a considerable proportion of ~~all~~ cases ~~of phthisis~~ the dulness is first noted in these regions. The comparison between the two sides should be made also when the breath is held after a full inspiration, as the defective resonance may then be more clearly marked. In the early stages the percussion note is usually higher in pitch, and it may require an experienced ear to detect the difference. In recent consolidation from caseous pneumonia the percussion note often has a tympanitic quality. A wooden dulness is rarely heard except in old cases with extensive fibroid change at the apex or base. Over large, thin-walled cavities at the apex the so-called cracked-pot sound may be obtained. In thin subjects the percussion should be carefully practiced in the supraspinous fossæ and the interscapular space, as they correspond to very

important areas early involved in the disease. By light percussion along the border of the trapezius and in the supraclavicular and supraspinous fossæ, areas of apical resonance may be mapped out (Kronig's apical resonance zones). Under normal conditions the areas are equal on the two sides. Consolidation or retraction of an apex causes definite narrowing of the zone on the affected side. The procedure requires considerable skill. It gives valuable information in the early stage of infiltration. Goldscheider uses a special pleximeter and percusses out the borders of the apex of the lung projecting above the clavicle. The method is less satisfactory than that of Kronig. In cases with numerous isolated cavities at the apex, without much fibroid tissue or thickening of the pleura, the percussion note may show little change, and the contrast between the signs obtained an auscultation and percussion is most marked. In the direct percussion of the chest, particularly in thin patients over the pectorals, one frequently sees the phenomenon known as *myoidema*, a local contraction of the muscle causing bulging, which persists for a variable period and gradually subsides. It has no special significance.

(*d*) *Auscultation.*—Feeble breath-sounds are among the most characteristic early signs, since not as much air enters the tubes and vesicles of the affected area. It is well at first always to compare carefully the corresponding points on the two sides of the chest without asking the patient either to draw a deep breath or to cough. With early apical disease the inspiration on quiet breathing may be scarcely audible. Expiration is usually prolonged. On the other hand, there are cases in which the earliest sign is a harsh, rude, respiratory murmur. On deep breathing it is frequently to be noted that inspiration is jerking or wavy, the so-called "cog-wheel" rhythm; which, however, is by no means confined to tuberculosis. With extension of the disease the inspiratory murmur is harsh, and, when consolidation occurs, whiffing and bronchial. With these changes in the character of the murmur there are râles. The patient should first breathe quietly, then take a full breath, and then cough. When heard with quiet breathing, if they persist and are present in one area only, they are of great importance. The fine rustling crepitus at one or both apices which is heard when the patient first takes a deep breath is of no moment. It may also be present at the bases. Râles at the end of deep inspiration which disappear on repeated breathing may also be disregarded. Râles which are brought out by coughing, which persist, and are repeatedly heard at the same spot are of the greatest importance. It is of equal import when moist, clicking râles are present with change in the percussion note. Attention to these ~~brief~~ rules will save many of the unnecessary diagnoses of pulmonary tuberculosis ~~at present~~ made on auscultatory signs alone.

When softening occurs the râles are louder and have a bubbling, sometimes a characteristic clicking quality. These "moist sounds," as they are called, when associated with change in the percussion resonance are extremely suggestive. When cavities form the râles are louder, more gurgling, and resonant in quality. When there is consolidation of any extent the breath sounds are tubular, and in the large excavations loud and cavernous, or have an amphoric quality. In the unaffected portions of the lobe and in the opposite lung the breath sounds may be harsh and even puerile. The vocal reso-

nance is usually increased in all stages of the process, and bronchophony and pectoriloquy are met with in the regions of consolidation and over cavities. Pleuritic friction may be present at any stage and, as mentioned before, occurs very early. There are cases in which it is a marked feature throughout. When the lappet of lung over the heart is involved there may be a pleuro-pericardial friction, and when this area is consolidated there may be curious clicking râles synchronous with the heart-beat, due to the compression by the heart of this portion with expulsion of air from it. An interesting auscultatory sign met with in thin-chested persons, in nervous patients, and often in early pulmonary tuberculosis is the so-called cardio-respiratory murmur, a whiffing systolic bruit due to the propulsion of air out of the tubes by the impulse of the heart. It is best heard during inspiration and in the antero-lateral regions of the chest.

A systolic murmur is frequently heard in the subclavian artery on either side, the pulsation of which may be very visible. The murmur is in all probability due to pressure on the vessels by the thickened pleura.

The signs of cavity may be here briefly enumerated.

(1) When there is not much thickening of the pleura or condensation of the surrounding lung-tissue, the percussion sound may be full and clear, resembling the normal note. More commonly there is defective resonance or a tympanitic quality which may at times be purely amphoric. The pitch of the percussion note changes over a cavity when the mouth is opened or closed (Wintrich's sign), or it may be brought out more clearly on change of position. The cracked-pot sound is obtainable only over tolerably large cavities with thin walls. It is best elicited by a firm, quick stroke, the patient at the time having the mouth open. In those rare instances of almost total excavation of one lung the percussion note may be amphoric in quality. (2) On auscultation the so-called cavernous sounds are heard: (i) Various grades of modified breathing—blowing or tubular, cavernous or amphoric. There may be a curiously sharp hissing sound, as if the air was passing from a narrow opening into a wide space. In very large cavities both inspiration and expiration may be typically amphoric. (ii) There are coarse bubbling râles which have a resonant quality, and on coughing may have a metallic or ringing character. On coughing they are often loud and gurgling. In very large thin-walled cavities, and more rarely in medium-sized cavities, surrounded by recent consolidation, the râles may have a distinctly amphoric echo, simulating those of pneumothorax. There are dry cavities in which no râles are heard. (iii) The vocal resonance is greatly intensified, and whispered broncophony is clearly heard. In large apical cavities the heart-sounds are well heard, and occasionally there may be an intense systolic murmur, probably always transmitted to, and not produced, as has been supposed, in the cavity itself. In large excavations of the left apex the heart impulse may cause gurgling sounds or clicks synchronous with the systole. They may even be loud enough to be heard at a little distance from the chest wall. A large cavity with smooth walls and thin fluid contents may give the succussion sound when the trunk is abruptly shaken (Walshe), and even the coin sound may be obtained.

Pseudo-cavernous signs may be caused by an area of consolidation near a large bronchus. The condition may be most deceptive—the high-pitched or

tympanitic percussion note, the tubular or cavernous breathing, and the resonant râles simulate closely the signs of cavity.

3. *Fibroid Phthisis*

In their monograph on Fibroid Diseases of the Lung, Clark, Hadley, and Chaplin make the following classification: 1. Pure fibroid—a condition in which there is no tubercle. 2. Tuberculo-fibroid disease—a condition primarily tuberculous, but which has run a fibroid course. 3. Fibro-tuberculous disease—a condition primarily fibroid, but which has become tuberculous. The tuberculo-fibroid form may come on gradually as a sequence of a chronic tuberculous broncho-pneumonia or follow a chronic tuberculous pleurisy. In other instances the process supervenes upon an ordinary ulcerative phthisis. The disease becomes limited to one apex, the cavity is surrounded by layers of dense fibrous tissue, the pleura is thickened, and the lower lobe is gradually invaded by the sclerotic change. Ultimately a picture is produced little if at all different from the condition known as cirrhosis of the lungs. It may even be difficult to say that the process is tuberculous, but in advanced cases the bacilli are usually present in the walls of the cavity at the apex, or old, encapsulated caseous areas are present, or there may be tubercles at the apex of the other lung and in the bronchial glands. Dilatation of the bronchi is present; the right ventricle, sometimes the entire heart, is hypertrophied.

The disease is chronic, lasting from ten to twenty or more years, during which time the patient may have fair health. The chief symptoms are cough, often paroxysmal in character and most marked in the morning, and dyspnœa on exertion. The expectoration is purulent, and in some instances, when the bronchiectasis is extensive, fetid. There is rarely any fever.

The physical signs are very characteristic. The chest is sunken and the shoulder lower on the affected side; the heart is often drawn over and displaced. If the left lung is involved there may be an unusually large area of cardiac pulsation in the third, fourth, and fifth interspaces. Heart murmurs are common. There are dulness and deficient tactile fremitus over the affected side, except over cavities where the fremitus is increased. At the apex there may be well-marked cavernous sounds; at the base, distant bronchial breathing. In some cases the other lung becomes involved, or the patient has repeated attacks of hæmoptysis, in one of which he dies. As a result of the chronic suppuration, amyloid degeneration of the liver, spleen, and intestines may take place; dropsy frequently supervenes from failure of the right heart.

A more detailed account is found under Cirrhosis of the Lung, with which this form is clinically identical.

Complications of Pulmonary Tuberculosis

In the Respiratory System.—The larynx is rarely spared in chronic pulmonary tuberculosis. The first symptom may be huskiness of the voice. There are pain, particularly in swallowing, and a cough which is often wheezing, and in the later stages very ineffectual. Aphonia and dysphagia are the two most distressing symptoms of the laryngeal involvement. When the epiglottis is seriously diseased and the ulceration extends to the lateral wall of the pharynx, the pain in swallowing may be very intense, or, owing to the

imperfect closure of the glottis, there may be coughing spells and regurgitation of food through the nostrils. Bronchitis and tracheitis are almost invariable accompaniments.

Pneumonia is a not infrequent complication of pulmonary tuberculosis. It may run a perfectly normal course, while in other instances resolution may be delayed, and one is in doubt, in spite of the abruptness of the onset, as to the presence of a simple or a tuberculous pneumonia. In some cases a pneumonia is a terminal complication.

Emphysema of the uninvolved portions of the lung is a common feature, rarely producing any special symptoms. There are, however, cases of chronic tuberculosis in which emphysema dominates the picture, and in which the condition comes on slowly during a period of many years. (General subcutaneous emphysema, which has been met with in a few rare cases, is due either to perforation of the trachea or to the rupture of a cavity adherent to the chest wall.)

Gangrene of the lung is an occasional event, ~~in chronic pulmonary tuberculosis~~, due in almost all instances to sphacelus in the walls of the cavity, rarely in the lung-tissue itself.

Complications in the Pleura.—A dry pleurisy is a very common accompaniment of the early stages of tuberculosis. It is always a conservative, useful process. In some cases it is very extensive, and friction murmurs may be heard over the sides and back. The cases with dry pleurisy and adhesions are, of course, much less liable to the dangers of pneumothorax. Pleurisy with effusion more commonly precedes than occurs in the course of pulmonary tuberculosis. Still, it is common enough to meet with cases in which a sero-fibrinous effusion arises in the course of the chronic disease. There are cases in which it is a special feature, and it often, I think, favors chronicity. A patient may during a period of four or five years have signs of local disease at one apex with recurring effusion in the same side. Owing to adhesions in different parts of the pleura, the effusion may be encapsulated. Hæmorrhagic effusions, which are not uncommon in connection with tuberculous pleurisy, are comparatively rare in chronic ~~phthisis~~. Chyliform or milky exudates are sometimes found. Purulent effusions are not frequent apart from pneumothorax. An empyema, however, may occur in the course of the disease or as a sequence of a sero-fibrinous exudate. *Pneumothorax* is an extremely common complication. Of 49 cases at the Johns Hopkins Hospital, 23 were tuberculous (Emerson). It may prove fatal in twenty-four hours. In other instances a pyo-pneumothorax follows and the patient lingers for weeks or months. In a third group of cases it seems to have a beneficial effect ~~on the course of the disease~~, and is sometimes produced for the therapeutic ~~effect~~ result.

Symptoms Referable to the Other Organs.—(*a*) *Cardio-vascular.*—The retraction of the left upper lobe exposes a large area of the heart. In thin-chested subjects there may be pulsation in the second, third, and fourth interspaces close to the sternum. Sometimes with much retraction of the left upper lobe the heart is drawn up. A systolic murmur over the pulmonary area and in the subclavian arteries is common in all stages of ~~phthisis~~. Apical murmurs are ~~also~~ not infrequent and may be extremely rough and harsh without necessarily indicating that endocarditis is present. The asso-

ciation of heart disease with phthisis is not, however, very uncommon. As already mentioned, there were 12 instances of endocarditis in 216 autopsies. The arterial tension is usually low and the capillary resistance lessened so that the pulse is often full and soft even in the later stages of the disease. The capillary pulse is not infrequently found, and pulsation of the veins in the back of the hand is occasionally seen.

(*b*) *Blood Glandular System.*—The early anæmia has already been noted. It is often more apparent than real, a chloro-anæmia, and the blood-count rarely sinks below two millions per cubic millimetre.

The blood-plates are, as a rule, enormously increased and are seen in the withdrawn blood as the so-called Schultze's granule masses. Without any significance, they are of interest chiefly from the fact that every few years some tyro announces their discovery as a new diagnostic sign of tuberculosis. The leucocytes are greatly increased, particularly in the later stages.

(*c*) *Gastro-intestinal System.*—The tongue is usually furred, but may be clean and red. Small aphthous ulcers are sometimes distressing. A red line on the gums, a symptom to which at one time much attention was paid as a special feature of phthisis, occurs in other cachectic states. Extensive tuberculous disease of the pharynx, associated with a similar affection of the larynx, may interfere seriously with deglutition and prove a very distressing and intractable symptom. The saliva has very full digestive powers.

Tuberculosis of the stomach is rare. Ulceration may occur as an accidental complication and multiple catarrhal ulcers are not uncommon. Interstitial and parenchymatous changes in the mucosa are common (possibly associated with the venous stasis) and lead to atrophy, but these cannot always be connected with the symptoms, and they may be found when not expected. On the other hand, when the gastric symptoms have been most persistent the mucosa may show very little change. It is impossible always to refer the anorexia, nausea, and vomiting of consumption to local conditions. The hectic fever and the neurotic influences upon which Immermann lays much stress must be taken into account, as they play an important rôle. The organ is often dilated, and to muscular insufficiency alone may be due some of the cases of dyspepsia. The condition of the gastric secretion is not constant, and the reports are discordant. In the early stages there may be superacidity; later, a deficiency of acid.

Anorexia is often a marked symptom at the onset; there may be positive loathing for food, and even small quantities cause nausea. Sometimes, without any nausea or distress after eating, the feeding of the patient is a daily battle. When practicable, Debove's forced alimentation is of great benefit in such cases. Nausea and vomiting, though occasionally troublesome at an early period, are more marked in the later stages. The latter may be caused by the severe attacks of coughing. S. H. Habershon refers to four different causes of the vomiting in phthisis: (1) central, as from tuberculous meningitis; (2) pressure on the vagi by caseous glands; (3) stimulation from the peripheral branches of the vagus, either pulmonary, pharyngeal, or gastric; and (4) mechanical causes.

Of the *intestinal* symptoms diarrhœa is the most serious. It may come on early, but is more usually a symptom of the later stages, and is associated with ulceration, particularly of the large bowel. Extensive ulceration of the

ileum may exist without any diarrhœa. The associated catarrhal condition may account in part for it, and in some instances the amyloid degeneration of the mucous membrane. Perforation occurred in 13 of 475 autopsies in chronic pulmonary tuberculosis.

(*d*) *Nervous System.*—(1) Focal lesions due to the development of coarse tubercles and areas of tuberculous meningo-encephalitis. Aphasia, for instance, may result from the growth of meningeal tubercles in the fissure of Sylvius, or even hemiplegia may occur. The solitary tubercles are more common in the chronic ~~phthisis~~ of children. (2) Basilar meningitis is an occasional complication. It may be confined to the brain, though more commonly it is a (3) cerebro-spinal meningitis, which may come on in persons without well-marked local signs in the chest. Twice have I known strong, robust men brought into hospital with signs of cerebro-spinal meningitis, in whom the existence of pulmonary disease was not discovered until the post mortem. (4) *Peripheral neuritis,* which is not common, may cause an extensor paralysis of the arm or leg, more commonly the latter, with foot-drop. It is usually a late manifestation. (5) Mental symptoms. It was noted, even by the older writers, that consumptives had a peculiarly hopeful temperament, and the *spes phthisica* forms a curious characteristic of the disease. Patients with extensive cavities, high fever, and too weak to move will often make plans for the future and confidently expect to recover.

Apart from tuberculosis of the brain, there is sometimes in chronic ~~phthisis~~ a form of insanity not unlike that which occurs in the convalescence from acute affections.

(*e*) A remarkable *hypertrophy of the mammary gland* may occur in pulmonary tuberculosis, most commonly in males. It may be only on the affected side. It is a chronic interstitial, non-tuberculous mammitis (Allot). Mastitis adolescentium, not very uncommon, is not necessarily suggestive of pulmonary tuberculosis.

(*f*) *Genito-urinary System.*—The urine presents no special peculiarities in amount or constituents. Fever, however, has a marked influence upon it. Albumin is met with frequently and may be associated with the fever, or is the result of definite changes in the kidneys. In the latter case it is more abundant and more curd like. Amyloid disease of the kidneys is not uncommon. Its presence is shown by albumin and tube casts, and sometimes by a great increase in the amount of urine. In other instances there is dropsy, and the patients have all the characteristic features of chronic ~~Bright's disease~~.

Pus in the urine may be due to disease of the bladder or of the pelves of the kidneys. In some instances the entire urinary tract is involved. In pulmonary ~~phthisis~~, however, extensive tuberculous disease is rarely found in the urinary organs. Bacilli may occasionally be detected in the pus. Hæmaturia is not a very common symptom. It may occur occasionally as a result of congestion of the kidneys, and pass off, leaving the urine albuminous. In other instances it results from disease of the pelvis or of the bladder, and is associated either with early tuberculosis of the mucous membranes or more commonly with ulceration. In a medical clinic the routine inspection of the testes for tubercle will save two or three mistakes a year.

(*g*) *Cutaneous System.*—The skin is often dry and harsh. Local tubercles occasionally occur on the hands. There may be pigmentary staining,

the *chloasma phthisicorum,* which is more common when the peritoneum is involved. Upon the chest and back the brown stains of *pityriasis versicolor* are very frequent. The hair of the head and beard may become dry and lanky. The terminal phalanges, in chronic cases, become clubbed and the nails incurvated—the Hippocratic fingers. Landouzy has called attention to a curious bending, usually of the ring and little fingers, which permits of flexion, but not of extension—a condition which he calls camptodactaly. A remarkable and unusual complication is general emphysema, which may result from ulceration of an adherent lung or perforation of the larynx.

Diagnosis of Pulmonary Tuberculosis.

With fever, well-marked physical signs and bacilli in the sputum, no disease is more easily diagnosed, than pulmonary tuberculosis. Successful treatment depends largely upon early diagnosis, and special attention must be paid to the obscure, variable, and uncertain symptoms and signs of the initial stage. The active crusade against the disease has made both the public and the profession more alert, and we have, as so often happens, gone to an extreme, and are apt to see early tuberculosis in trivial complaints. I say this from an experience of cases seen in consultation, and it is borne out by the records of institutions. Hamman, in charge of the Phipps Tuberculosis Dispensary of the Johns Hopkins Hospital, makes the interesting confession that in the early days, when they depended on slight physical signs and the tuberculin reaction, there were innumerable early cases, but with a wider experience and greater confidence in clinical symptoms the outlook on these borderland cases has changed completely, and now, instead of condemning them peremptorily to a sanatorium, they are found to keep well under the ordinary conditions of life, in spite of the persistence of slight abnormal signs. How important this feature of tuberculosis work has become is also indicated by the figures for the first year at the Tuberculosis Dispensary of the Radcliffe Infirmary. Of the 580 cases, all sent by physicians, 213 were found not to be tuberculous! One lesson from the work of the past few years is that we should pay more attention to symptoms than to physical signs. The following are the points of special importance in the diagnosis of early cases:

History.—Tuberculosis in the family, "Phthisical habitus," unusual exposure, special debilitating circumstances, as worry, grief, dissipation, or a chronic illness.

Symptoms.—Loss of weight, loss of strength, and anæmia, if progressive and not to be accounted for by mental worries or prolonged indigestion, are of first importance. Fever is at once a most trustworthy and the most fallacious symptom. The thermometer has needlessly condemned many patients to the sanatorium. Regard should be had to the points already mentioned in speaking of the fever. In nervous persons, particularly in stout, flabby young girls, a temperature from 99.5° to 100.5° may mean nothing, and the rectal temperature is often very deceptive: if taken after exercise or excitement it may be a degree and a half above normal. In the case of a flabby, fat girl of ten, with an anxious mother, a foolish nurse, and an alarmist doctor, for months the rectal temperature was taken hourly during the day; the child had been in bed; there was no cough, and the only physical sign a few rustling râles at one apex. The *cure* followed rapidly on the

breaking of the thermometer and getting rid of the nurse. In a suspicious case a two-hour temperature record should be taken during the day for ten days and the influence of exercise upon it carefully estimated.

A cough is always suspicious in the young, more in the winter than in the summer, and more in the morning than at other times in the day. Throat conditions should be carefully excluded, particularly the irritation from cigarette smoking. The spitting of blood has already been considered sufficiently, and its importance in the diagnosis of tuberculosis is universally recognised. A brisk, early hæmoptysis is often helpful, not only for the positive information it gives us, but for its useful moral effect on the patient. The greater the care with which the bloody sputum is examined the more likely will it be that bacilli are found.

Sputum.—The patient should be instructed to collect what is expectorated, particularly early in the morning, and everything brought up should be sent. The difficulty in private practice is that it requires a long series of examinations to exclude positively the presence of tubercle bacilli. Time and again with suspicious cases, or in pleurisy with effusion, I have asked a clinical clerk day by day "Any bacilli yet?", and in one instance there were none found until the twentieth examination! Of course, in private practice this is impossible, but it is well to bear in mind that one or two negative examinations are not sufficient. Various methods of digesting the sputum and examining the centrifugalized sediment are important when few bacilli are present. The antiformin method introduced by Uhlenhuth is simple and often reveals tubercle bacilli missed by an ordinary examination.

Physical Signs.—These raise the difficulty. At present, so far as the lungs are concerned, the position resembles that of twenty-five years ago in respect to the heart, when any murmur was regarded as serious. Now, if we see the apex beat within the nipple line and there is no shortness of breath, and the pulse is regular, we discount physical signs and tell the patient to live a rational life. This is what we should do with many cases of suspected early tuberculosis. If the symptoms above dealt with are not present, "discount" the physical signs. These have already been considered: change in the character of the respiratory murmur and the presence of râles are the two most important, as dulness is rarely present in early cases. Altogether too much stress has been laid upon roughened or impure inspiration associated with a few dry râles. Only upon repeated examination should a decision be reached. Practically, in these early cases, we have two groups—the one with symptoms and no physical signs, and the other with physical signs and no symptoms. Of the two, the former is of the greater importance.

Specific Reaction.—*Tuberculin Test.*—The experience of hundreds of observers in different parts of the world testifies to the value of the Calmette and the von Pirquet tests. But we must remember the reaction simply means that the organism has developed a responsive activity to tuberculous infection, and it by no means indicates that an individual has tuberculous disease, in the ordinary sense of the term "disease." From the careful studies made at the Phipps Dispensary, the conjunctival test was found of the greater value in indicating the presence of an active lesion. The following conclusions reached by Hamman and his colleagues appear to be sane: "When a patient fails to react to either test, and there are no striking symptoms or

physical signs of pulmonary disease, we feel that the negative diagnosis has received a valuable confirmation. If the eye reaction is positive, this is a strong indication that the patient has an active tuberculous focus; if symptoms and signs are present it is an important aid in excluding other pulmonary conditions; if they are absent it marks the patient as a suspect. * * * None of these tests can replace in the slightest degree a carefully taken history and a well-made examination. They can never stand censor over these; rather their value must ultimately be judged by them. They are aids and nothing more."

While the cutaneous and conjunctival are the more important as a routine procedure, still in special instances in which it is desired to elicit a focal reaction the subcutaneous tuberculin test is invaluable.

X-ray Diagnosis.—In skilful hands the study of cases with the Röntgen rays is of great value. In a normal case the radiogram shows a shadow beneath and extending beyond the sternum due to the contents of the mediastinum. Extending from the mediastinum and radiating out into the various lobes is a series of shadows which may be likened to the branches of a tree, the thickest shadow being at the hilus and thinning toward the periphery of the lungs. In diseased conditions changes are seen in the hilus, shadows due to enlarged or calcified glands and to the increase in the fibrous and lymphatic tissues in the mediastinum. The pulmonary vessels with their contained blood play an important part in the production of the shadow. A study made at the Phipps' Dispensary by Dunham, Boardman, and Wolman showed that in a very large percentage of all the early cases, clinically found to be tuberculosis, these shadows showed certain changes which corresponded to the clinical findings. It is not proved, however, that other pulmonary conditions, such as those produced by the influenza bacillus, may not cause the same changes. The X-rays undoubtedly show very early changes in the lungs, but they can not determine the etiological factor. In the majority of cases the X-rays tell no more than a careful clinical examination, and they do not differentiate an active from a healed lesion. More than any others, radiographers need the salutory lessons of the dead house to correct their visionary interpretations of shadows, particularly of those radiating from the roots of the lungs.

Concurrent Infections and Diseases Associated with Pulmonary Tuberculosis

Concurrent Infections in Pulmonary Tuberculosis.—It has long been known that in pulmonary tuberculosis organisms other than the specific bacilli are present, particularly *Micrococcus lanceolatus, Streptococcus pyogenes,* the influenza bacillus, *Micrococcus catarrhalis,* and *Staphylococcus aureus;* less frequently *Bacillus pyocyaneus.*

Many cases of pulmonary tuberculosis are combined infections; streptococci and pneumococci may be found in the sputum, and the former have been isolated from the blood. Prudden, who has very carefully studied this question, arrives at the following conclusions: The pulmonary lesions of tuberculosis are subject to variations depending largely on the different modes of distribution of the bacilli, whether by the blood vessels or through the bronchi, and also whether a concurrent infection with other organisms has taken

Diagnosis when marked changes

a pul. process which has gone to the stage of tissue destruction
with mt tb in sputum is prob. not tuberculous.

—

presence of elastic tissue + absence of tb. in sputum Specimen
is against tuberculosis.

—

complement fixation test is nearly always positive in active
tuberculosis. Miller. J.A.M.A. 67. 1516. 1517.
antigen prepared by grinding living or dead tb. with dry tube
salt & then adding water to sterility
Test usually negative in [illegible]

Comp. fix test. especially useful when no bacilli found - Several neg. tests
recommended also Deb. condition in apparently normal [illegible]

Cases with marked tuberculous tendency [illegible]

[illegible]

the Pneumococcus

Lorau par mise [illegible]

le
maréchal

place. The pneumonia complicating tuberculosis may be the direct result of the tubercle bacillus or its toxins, or it may follow secondary infection with other germs, particularly the *Streptococcus pyogenes,* the *Micrococcus lanceolatus,* and the *Staphylococcus pyogenes.* An infection with the influenza bacillus or *Micrococcus catarrhalis* may be followed by increased fever and an aggravation of the general symptoms. The frequency of these secondary infections and the relative significance of their germs are not yet fully decided. It is very probable that in man the effect of contamination with the pus organisms is a very important one in hastening necrosis and softening, and also in the chronic cases they doubtless produce in large amounts the toxins which are responsible for many of the symptoms of the disease. The work of Hastings indicates that secondary infections are not so important as we had thought, and a study by Radcliffe at the King Edward Sanatorium points in this direction.

Diseases Associated with Pulmonary Tuberculosis.—*Lobar pneumonia* is a not uncommon cause of death. It is met with most frequently, indeed, as a terminal event in the chronic cases. It may, however, occur early, and be difficult to distinguish from an acute caseous pneumonia. The sputum in the latter is rarely rusty, while the fever in the former is more continuous and higher, but in many cases it is impossible to differentiate between the two conditions.

The association of tuberculosis and *typhoid fever* has already been discussed (page 32).

Erysipelas not infrequently attacks old *poitrinaires* in hospital wards and almshouses. There are instances in which the attack seems to be beneficial, as the cough lessens and the symptoms ameliorate. It may, however, prove fatal.

The *eruptive fevers,* particularly measles, frequently precede but rarely occur in the course of pulmonary tuberculosis. In the revaccination of a tuberculous subject the vesicles run a normal course.

Fistula in ano, so often associated with pulmonary tuberculosis, in a majority of such cases is a tuberculous process. The general affection may progress rapidly after an operation. The question is considered in tuberculosis of the alimentary canal.

Heart Disease.—Cardiac hypoplasia seems uncommon in tuberculosis, though it was much referred to by the older writers. It was present in only 3 cases in 1,764 autopsies on tuberculous patients (Norris). Rokitansky taught that there was an antagonism between valvular lesions and aneurisms and tuberculosis. All forms of congenital heart disease predispose to it, particularly stenosis of the pulmonary artery. Mitral stenosis, on the other hand, has a distinctly inhibitory influence. The two conditions are rarely found associated. Endocarditis has already been referred to. A terminal acute tuberculosis, particularly of the serous membranes, is not at all uncommon in cardio-vascular diseases.

In chronic and arrested phthisis *arterio-sclerosis* and *phlebo-sclerosis* are not uncommon. Ormerod noted 30 cases of chronic renal disease in 100 post mortems.

The association of tuberculosis with *chronic arthritis,* upon which certain writers lay stress, finds its explanation in the lowered resistance of these pa-

tients and the greater liability to infection in the institutions in which so many of them live.

Peculiarities of Pulmonary Tuberculosis at the Extremes of Life

Old Age.—It is remarkable how common tuberculosis is in the aged, particularly in institutions. McLachlan noted 145 cases in which tuberculosis was the cause of death in old persons in Chelsea Hospital. All were over sixty years of age. The experience at the Salpêtrière is the same. Laennec met with a case in a person over ninety-nine years of age.

At the Philadelphia Hospital, in the bodies of aged persons sent over from the almshouse, it was extremely common to find either old or recent tuberculosis. A patient died under my care at the age of eighty-two with extensive peritoneal tuberculosis. Pulmonary tuberculosis in the aged is usually latent and runs a slow course. The physical signs are often masked by emphysema and by the coëxisting chronic bronchitis. The diagnosis may depend entirely upon the discovery of the bacilli and elastic tissue. Contrary to the opinion which was held some years ago, tuberculosis is by no means uncommon with senile emphysema. Some of the cases of tuberculosis in the aged are instances of quiescent disease which may have dated from an early period.

Infancy.—The occurrence of acute tuberculosis in children has already been mentioned, and also the fact that the disease is occasionally congenital. The incidence is very variable, from 13 to 42 per cent. in collected statistics. In Wollstein's study from the New York Babies' Hospital, among 1,131 autopsies in children under four years of age, in 192 tuberculosis was present; the percentage was: first year 1.8 per cent., second year 11 per cent., third year 16 per cent., and fourth year 23 per cent. Chronic ulcerative tuberculosis of the lungs is much more rare than in adults. In Parrot's series of 219 cases in children under three years of age, in only 57 were cavities found in the lungs.

Modes of Death in Pulmonary Tuberculosis

(a) By asthenia, a gradual failure of the strength. The end is usually peaceable and quiet, occasionally disturbed by paroxysms of cough. Consciousness is often retained until near the close.

(b) By asphyxia, as in some cases of acute miliary tuberculosis and in acute pneumonic phthisis. In chronic phthisis it is rarely seen, even when pneumothorax develops.

(c) By syncope. This is not common. I have known it to happen once or twice in patients who insisted upon going about when in the advanced stages of the disease. There may be, but not necessarily, fatty degeneration of the heart. Rapid syncope may follow hæmorrhage or may be due to thrombosis or embolism of the pulmonary artery, or to pneumothorax.

(d) From hæmorrhage. The fatal bleeding in chronic phthisis is due to erosion of a large vessel or rupture of an aneurism in a pulmonary cavity, most commonly the latter. Of 26 cases analyzed by S. West, in 11 the fatal hæmoptysis was due to aneurism, and, of 35 cases collected by Percy Kidd, aneurism was present in 30. In a case of Curtin's, at the Philadelphia Hospital, the bleeding proved fatal before hæmoptysis occurred, as the eroded vessel opened into a capacious cavity.

(e) With cerebral symptoms. Coma may be due to meningitis, less often to uræmia. Death in convulsions is rare. The hæmorrhagic pachy-meningitis which occurs in some cases of phthisis occasionally causes loss of consciousness, but is rarely a direct cause of death. In one of my cases death resulted from thrombosis of the cerebral sinuses with symptoms of meningitis.

V. TUBERCULOSIS OF THE ALIMENTARY CANAL

(a) Lips.—Tuberculosis of the lip is very rare. It occurs occasionally in the form of an ulcer, either alone or more commonly in association with laryngeal or pulmonary disease. The ulcer is usually very sensitive and may be mistaken for a chancre or an epithelioma. The diagnosis may be made in cases of doubt by inoculation or the examination of a portion for tubercle bacilli.

(b) Tongue.—The disease begins by an aggregation of small granular bodies on the edge or dorsum. Ulceration proceeds, leaving an irregular sore with a distinct but uneven margin, and a rough, often caseous base. The disease extends slowly and may form an ulcer of considerable size. I have known it to be mistaken for epithelioma and the tongue to be excised. It is rarely met with except when other organs are involved. The glands of the angle of the jaw are not enlarged and the sore does not yield to iodide of potassium, which are points of distinction between the tuberculous and the syphilitic ulcer. In doubtful cases the inoculation test should be made, or a portion excised for microscopic examination.

(c) Salivary Glands.—The salivary glands belong to that small group of organs of the body which seem to possess an immunity; a very few cases have been reported.

(d) Palate.—Tubercles of the hard or soft palate nearly always follow extension of the disease from neighboring parts.

(e) Tuberculosis of the Tonsils.—In 7 of 45 consecutive cases in children from three months to fifteen years, A. Latham demonstrated, by inoculation, the presence of tuberculosis of the tonsils either in organs removed by operation or post mortem. The observation is of interest in connection with the views of Schlenker, who claims that the majority of the cases of tuberculous cervical glands result from infection with tubercle bacilli which gain admission by way of the tonsil. A large number of his cases of tuberculous cervical adenitis were definitely of a descending variety and associated with tuberculosis of these glands. The majority also had pulmonary tuberculosis, and he regards surface infection of the tonsil by tuberculous food and sputum far more common than infection by way of the circulation. The disease may occur as a superficial ulceration. More commonly there is an infiltration of the tonsil with miliary tubercles, which produces a greater or less hypertrophy which it is practically impossible to distinguish from an ordinary enlargement of the tonsil without a microscopic examination.

(f) Pharynx.—In extensive laryngeal tuberculosis an eruption of miliary granules on the posterior wall of the pharynx is not very uncommon. In chronic phthisis an ulcerative pharyngitis, due to extension of the disease from the epiglottis and larynx, is one of the most distressing of complications, rendering deglutition acutely painful. Adenoids of the naso-pharynx

may be tuberculous, as shown by Lermoyez. Macroscopically, they do not differ from the ordinary vegetations found in this situation.

(g) Œsophagus.—A few instances occur in the literature of tuberculosis of the œsophagus. The condition is a pathological curiosity, except in the slight extension from the larynx, which is not infrequent; but in a case in my wards, described by Flexner, the ulcer perforated and caused purulent pleurisy. The condition has been fully considered by Claribel Cone, who has described a second case from the Johns Hopkins Hospital (Bulletin, November, 1897).

(h) Stomach.—Many cases are reported which are doubtful. Primary disease is unknown. Perforation of the stomach occurred six times in the 12 cases collected by Marfan, thrice by a tuberculous gland. In Oppolzer's case an ulcer of the colon perforated the organ. In Musser's case there was a large tuberculous ulcer 3 by 1½ inches in extent. Three cases have been described from my wards by Alice Hamilton (J. H. H. Bulletin, April, 1897).

(i) Intestines.—The tubercles may be (1) primary in the mucous membrane, or more commonly (2) secondary to disease of the lungs, or in rare cases the affection may (3) pass from the peritoneum.

(1) Primary intestinal tuberculosis occurs most frequently in children, in whom it may be associated with enlargement and caseation of the mesenteric glands, or with peritonitis. As stated, there is great discrepancy in the statistics on this point, and the question needs careful study. Biedert gives 16 cases in 3,104 instances of tuberculosis in children. In adults primary intestinal tuberculosis is rare, occurring in but 1 instance in 1,000 autopsies upon tuberculous adults at the Munich Pathological Institute; but now and then cases occur in which the disease sets in with irregular diarrhœa, moderate fever, and colicky pains. In a few cases hæmorrhage has been the initial symptom. Regarded at first as a chronic catarrh, it is not until the emaciation becomes marked or the signs of disease appear in the lungs that the true nature is apparent. Still more deceptive are the cases in which the tuberculosis begins in the cæcum and there are symptoms of appendicitis—tenderness in the right iliac fossa, constipation, or an irregular diarrhœa and fever. These signs may gradually disappear, to recur again in a few weeks and still further complicate the diagnosis. Fatal hæmorrhage has occurred in several of my cases. Perforation may occur with the formation of a pericæcal abscess, or perforation into the peritoneum may take place, or in very rare instances there is partial healing with great thickening of the walls and narrowing of the lumen.

(2) Secondary involvement of the bowels is very common in chronic pulmonary tuberculosis, *e. g.*, in 566 of the 1,000 Munich autopsies in tuberculosis just referred to. In only three of these cases were the lungs not involved. The lesions are chiefly in the ileum, cæcum, and colon. The affection begins in the solitary and agminated glands, or on the surface of or within the mucosa. The caseation and necrosis lead to ulceration, which may be very extensive and involve the greater portion of the mucosa of the large and small bowels. In the ileum the Peyer's patches are chiefly involved and the ulcers may be ovoid, but in the jejunum and colon they are usually round or transverse to the long axis. The tuberculous ulcer has the following characters: (*a*) It is irregular, rarely ovoid or in the long axis, more

frequently girdling the bowel; (*b*) the edges and base are infiltrated, often caseous; (*c*) the submucosa and muscularis are usually involved; and (*d*) on the serosa may be seen colonies of young tubercles or a well-marked tuberculous lymphangitis. Perforation and peritonitis are not uncommon events in the secondary ulceration. Stenosis of the bowel from cicatrization may occur; the strictures may be multiple.

Localized chronic tuberculosis of the *ileo-cæcal region* is of great importance. The cæcum may present a chronic hyperplastic tuberculosis, which not uncommonly extends into the appendix. As a consequence of the changes produced a definite tumor-like mass is formed in the right iliac fossa. This varies in size, is usually elongated in a vertical direction, hard, slightly movable, or bound down by adhesions and very sensitive to pressure. The tumor simulates more or less closely a true neoplasm of this region, particularly carcinoma. The condition is characterized by gradual constriction of the lumen of the bowel, periodic attacks of severe pain, and alternating diarrhœa and constipation. The extremely localized character of the disease warrants an exploratory operation, as the results of enterectomy are remarkably favorable. Of 11 cases reported by F. M. Caird, 7 recovered. In a second form of this disease, occurring less frequently than the former, there is no definite tumor mass to be felt, but a general induration and thickening in the right iliac fossa similar to the local changes produced by a recurring appendicitis. In this variety a fistula discharging fæcal matter occasionally results. Both forms may be distinguished ~~from the diseases they simulate~~ by the finding of tubercle bacilli in the stools or in the discharge from the fistula when such exists.

Tuberculosis of the *rectum* has a special interest in connection with *fistula in ano*, which occurs in about 3.5 per cent. of cases of pulmonary disease. In many instances the lesion has been shown to be tuberculous. It is very rarely primary, but if the tissue on removal contains bacilli and is infective the lungs are almost invariably ~~found to be~~ involved. It is a common opinion that the pulmonary symptoms progress rapidly after the fistula is cut. This may have some basis if the operation consists in laying the tract open, and not in a free excision.

(3) Extension from the peritoneum may excite tuberculous disease in the bowels. The affection may be primary in the peritoneum or extend from the tubes in women or the mesenteric glands in children. The coils of intestines become matted together, caseous and suppurating foci develop between the folds, and perforation may take place between the coils.

VI. TUBERCULOSIS OF THE LIVER

This organ is very constantly involved in (*a*) *Miliary tuberculosis.* This is seen in acute generalized tuberculosis, though the granules may be small and have to be looked for very carefully. In chronic tuberculosis miliary tubercles are not at all uncommon in the liver. (*b*) *Solitary tubercle.* Occasionally large tuberculous masses are found in the organ, sometimes associated with perihepatitis, sometimes with tuberculous peritonitis, and in children with tuberculous adenitis. In a few cases the masses are very large, though it is only in exceptional cases that the tumor can be felt through

the abdominal wall. The organ may be enlarged by numerous caseous masses and present the clinical picture of an enlarged rough tender liver with jaundice, as in a case reported by Thayer. The solitary tubercles become infected with pus organisms, soften, and form an abscess. (*c*) *Tuberculosis of the bile ducts.* This is by far the most characteristic tuberculous change in the organ, and is not uncommon. It was well described by Bristowe in 1858. The liver is enlarged, and section shows numerous small cavities, which look at first like multiple abscesses in suppurative pylephlebitis, but the pus is bile-stained and the whole process is a local tuberculous cholangitis. (*d*) *Tuberculous cirrhosis.* With the eruption of miliary tubercles there may be slight increase in the connective tissue, which is overshadowed by the fatty change. In all the chronic forms of tubercle in this organ there may be fibrous overgrowth. Hanot, who has described several varieties, states that the condition may be primary. Practically it is very rare, except in connection with chronic tuberculous peritonitis and perihepatitis, when the organ may be much deformed by a sclerosis involving the portal canals and the capsule, which may be greatly involved in a polyserositis.

VII. TUBERCULOSIS OF THE BRAIN AND CORD

Tuberculosis of the *brain* occurs as (*a*) an acute miliary infection causing meningitis and acute hydrocephalus; (*b*) as a chronic meningo-encephalitis, usually localized, and containing small nodular tubercles; and (*c*) as the so-called solitary tubercle. Between the last two forms there are all gradations, and it is rare to see the meninges uninvolved. The acute variety has already been considered. I shall here consider the chronic form, which comes on slowly and has the clinical characters of a tumor.

It is most common in the young. Of 148 cases collected by Pribram 118 were under fifteen years of age. Other organs are usually involved, particularly the lungs, the bronchial glands, or the bones. In rare instances no tubercles are found elsewhere. They occur most frequently in the cerebellum; next in the cerebrum, and then in the pons. The growths are often multiple, in 100 out of 183 cases (Gowers). They range in size from a pea to a walnut; large tumors occasionally occur, and sometimes an entire lobe of the cerebellum is affected. On section the tubercle presents a grayish-yellow, caseous appearance, usually firm and hard, and encircled by a translucent, softer tissue. The centre of the growth may be semi-diffluent. As in other localities the tubercle may calcify. The tumors are as a rule attached to the meninges, often to the pia at the bottom of a sulcus so that they look imbedded in the brain-substance. About the longitudinal fissure there may be an aggregation of the growths, with compression of the sinus, and the formation of a thrombus. The tuberculous tumor not infrequently excites acute meningitis. In localized meningo-encephalitis the pia is thickened, tubercles are adherent to the under surface and grow about the arteries. It is often combined with cerebral softening from interference with the circulation. Several of the most characteristic instances which I have seen were on the meninges covering the insula. This form may occur in pulmonary tuberculosis, causing hemiplegia or aphasia which may persist for months.

The symptoms of tuberculous growths in the brain are those of tumor, and will be considered in the section on the brain.

In the *spinal cord* the same forms are found. The acute tuberculous meningitis has been considered and is almost always cerebro-spinal. The solitary tubercle of the cord is rare. Herter reported 3 cases and collected 24 from the literature. It was secondary in all save one case. The symptoms are those of spinal tumor or meningitis.

VIII. TUBERCULOSIS OF THE GENITO-URINARY SYSTEM

The studies of the past few years, and particularly the work of surgeons and gynæcologists, have taught us the great importance of tuberculosis of this tract. Any part of the genito-urinary system may be invaded. The successive involvement of the organs may be so rapid that unless the case has been seen early it may be impossible to state with any degree of certainty which has been the primary seat of infection. There may be simultaneous involvement of various portions of the tract. In tuberculosis of the genito-urinary system one always has to bear in mind the possibility of latent disease elsewhere in the body. As Bollinger says, tubercle bacilli may gain admission at some part of the respiratory tract without producing any lesion at the point of entrance, and finally reach a bronchial gland, where they set up a tuberculous process of extremely slow development without producing any symptoms. From this point bacilli may enter the blood stream and lodge in the epididymis or testicle proper, and produce nodules which are readily discovered owing to the ease with which these parts are examined. Such a case might be quite easily mistaken for one of primary genital tuberculosis, whereas the true primary tuberculous focus is far distant.

Infection of the genito-urinary tract occurs in various ways:

(*a*) By Hereditary Transmission.—It has been met with in the fetus. The comparative frequency of tuberculosis of the testicle in very young children suggests very strongly that the uro-genital organs may be involved as a result of direct transmission of the disease.

(*b*) By Infection from Areas of Tuberculosis Already Existing in the Patient.—(1) *Infection through the Blood.*—In many cases uro-genital tuberculosis is found at autopsy associated with disease of some distant organ, particularly the lungs, and it would appear most probable that in them infection has been through the blood-vessels. Jani's observations, which were published by Weigert after the author's death, strongly support this theory. In studying sections of the genital organs of patients who died of pulmonary tuberculosis, he found tubercle bacilli in 5 out of 8 cases in the testicle, and in 4 out of 6 cases in the prostate, without in any instance finding microscopic evidences of tubercles in these organs. The bacilli lay, in the testis, partly within and partly close beside the cellular and granular contents of the seminal tubules, while in the prostate they were always situated in the neighborhood of the glandular epithelium.

(2) *Infection from the Peritoneum.*—This source of infection, in both men and women, is much more frequent than is commonly supposed. The intimate relationship between the peritoneum and bladder in both sexes, and with the vesiculæ seminales and vasa deferentia in the male, allows a ready way of invasion of these organs by direct extension of the disease. The peritoneum is a frequent source of genital tuberculosis in the female. No

doubt many cases of tuberculosis of the Fallopian tubes originate from this source. The fact that the fimbriated extremity of the tube is often most seriously involved points ~~rather strongly~~ in this direction, although the fact might be taken as a point in favor of blood infection, favored by its greater vascularity. Various observations go to show that the action of the cilia lining the lumina of the Fallopian tubes tends to attract particles introduced into the peritoneal cavity. Jani's observation is ~~very~~ interesting in this connection, as showing the possibility of tubercle bacilli entering the tubes from the peritoneal cavity without there being any tuberculous peritonitis. He found typical tubercle bacilli in the lumen, in sections of a normal Fallopian tube, in a woman who died of pulmonary and intestinal tuberculosis. The explanation advanced was that the bacilli made their way through the thin peritoneal coat from one of the intestinal ulcers, thus reaching the peritoneal cavity, and thence were attracted into the Fallopian tube by the current produced by the action of the cilia lining the lumen. The intimate relationship between tuberculous peritonitis and tuberculosis of the Fallopian tubes is shown in the fact that the latter are affected in from 30 to 40 per cent. of the cases.

(3) *Infection from Other Organs by Direct Extension.*—The occurrence of direct extension from the peritoneum has already been mentioned. In tuberculous ulceration of the intestine or rectum adhesions to the bladder in the male or to the uterus and vagina in the female may occur, with resulting fistulæ and a direct extension of the disease. Perirectal tuberculous abscesses may lead to secondary involvement of some portion of the genito-urinary tract. ~~It must not be forgotten that~~ Tuberculosis of the vertebræ may be followed by tuberculosis of the kidney as a result of direct extension of the disease.

(*c*) By Infection from Without.—Whether uro-genital tuberculosis may occur as a result of the entrance of tubercle bacilli into the urethra or vagina is still a disputed question. That bacilli gain admission to these passages during coitus with a person the subject of uro-genital tuberculosis, or by the use of foul instruments or syringes, seems quite probable. The possibility of genital tuberculosis occurring in the female as a result of coitus with a male the subject of tuberculosis in some portion of the genito-urinary system was first suggested by Cohnheim, who stated, however, that it rarely, if ever, occurred.

In a patient with intestinal tuberculosis the tubercle bacilli might accidentally reach the urethra or vagina from the rectum.

Uro-genital tuberculosis is commonest between the ages of twenty and forty years—that is, during the period of greatest sexual activity. Males are affected much more frequently than females, the proportion being 3 to 1. This great difference is no doubt partly due to the more intimate relationship between the urinary and genital systems in the former than in the latter. ~~In the male the urethra forms the common outlet for the two systems, while in the female there is a separate outlet for each.~~

Once the uro-genital tract has been invaded the disease is likely to spread rapidly, and the method of extension is an important one. Frequently there is direct extension, as when the bladder is involved secondarily to the kidney by passage of the disease along the ureter, or where the tuberculous process

extends along the vas deferens to the vesiculæ seminales. No doubt surface inoculation occurs in some instances, and to this cause may be attributed a certain percentage of cases of vesical and prostatic disease following tuberculosis of the kidney. Although this probability is acknowledged, there is an element of doubt as to the possibility of the kidney becoming affected secondarily to the bladder or prostate by the direct passage of the bacilli up the lumen of one ureter; for in such a case we have to suppose that a non-motile bacillus, contrary to the laws of gravity, ascends against an almost constant current of urine flowing in the opposite direction. The lymphatics ~~may~~ afford a means for the spreading of the disease, but in a greater number of cases than is generally supposed it takes place by way of the blood-vessels. Cystoscopic examinations of the bladder not infrequently show the presence of tubercles beneath the mucous membrane before there is any evidence of superficial ulceration—a fact suggesting strongly a blood infection.

The discovery of tubercle bacilli in the urine and the obtaining of tuberculous lesions in animals as a result of inoculation with the urinary sediment afford us the only positive evidence of genito-urinary tuberculosis. So far there are no authentic accounts of tubercle bacilli having been found in the semen of men with tuberculosis of the testicle or vesiculæ seminales. Owing to the fact that the smegma bacillus has the same staining reaction as the tubercle bacillus, and, morphologically is practically indistinguishable from it, the greatest care must be used in obtaining the specimen of urine for examination, to eliminate, if possible, all chances of contamination. ~~Thus the urine examined must be a catheterized specimen, and even then one runs the risk of carrying back into the bladder on the end of the catheter a few bacilli which may be washed out in the stream of urine and be mistaken for tubercle bacilli in the sediment.~~ One or more guinea-pigs should be inoculated with some of the suspected urine. If tubercle bacilli be present the animals will manifest tuberculous lesions in from three to five weeks.

Tuberculosis of the Kidneys ~~*(Phthisis Renum)*~~.—In general tuberculosis the kidneys frequently present scattered miliary tubercles. In pulmonary tuberculosis it is common to find a few nodules in the substance of the organ, or there may be pyelitis. In the first 17,000 admissions to the medical wards of the Johns Hopkins Hospital there were 1,085 cases of tuberculous infection. In 17 of these a clinical diagnosis of renal tuberculosis was made. Walker analyzed the first 1,369 autopsies in the same hospital and found that 784 had tuberculosis in some part of the body. In all there were 61 cases of renal tuberculosis. Of 482 cases of pulmonary tuberculosis showing symptoms during life, one or both kidneys were involved in 23. There were 36 cases of acute general miliary tuberculosis, and in every instance the kidney was affected. The 2 other cases of renal tuberculosis occurred in patients with latent disease. Primary tuberculosis of the kidneys is not very rare, but in no instance in the above series did Walker demonstrate a primary infection in the kidney. The tuberculous process was primary in some other part of the genito-urinary tract in 6 cases. In a majority of the cases the process involves the pelvis and the ureter as well, sometimes the bladder and prostate. It may be difficult to say in advanced cases whether the disease has started in the bladder, prostate, or vesicles, and crept up the ureters, or whether it started in the kidneys and proceeded downward. In a majority

of cases, I believe, the latter is true, and the infection is through the blood. Walker thinks that a hæmatogenous infection takes place in 90 per cent. of the cases, and that this is the channel of infection in the majority of instances where renal follows vesical tuberculosis rather than along the ureter. One kidney alone may be involved, and the disease creeps down the ureter and may only extend a few millimetres on the vesical mucosa. A man with aortic insufficiency, who had no lesions in the lungs, presented a localized patch in the pelvis of the kidney, involving a pyramid, while the ureter, 5 cm. from the bladder and at its orifice, was thickened and tuberculous. The prostate showed an area of caseation. The process is most common between twenty and thirty years of age, but it may occur at the extremes of age. In a series of 386 cases collected by Walker in which the sex was stated 182 of the patients were males and 204 females. In the earliest stage, which may be met with accidentally, the disease is seen to begin in the pyramids and calyces. Necrosis and caseation proceed rapidly, and the colonies of tubercles start throughout the pyramids and extend upon the mucous membrane of the pelvis. As a rule, from the outset it is a tuberculous pyo-nephrosis. The renal infection may result from direct extension of the disease from a tuberculous vertebra. It may be confined to one kidney, or progress more extensively in one than in the other. At autopsy both organs are usually found enlarged. In only 3 of the 61 autopsies previously referred to was the disease unilateral. One kidney may be completely destroyed and converted into a series of cysts containing cheesy substance—a form of kidney which the older writers called scrofulous. In the putty-like contents of these cysts lime salts may be deposited. In other instances the walls of the pelvis are thickened and cheesy, the pyramids eroded, and caseous nodules are scattered through the organ, even to the capsule, which may be thickened and adherent. The other organ is usually less affected, and shows only pyelitis or a superficial necrosis of one or two pyramids. The ureters are usually thickened and the mucous membrane ulcerated and caseous. Involvement of the bladder, vesiculæ seminales, and testes is not uncommon in males.

The SYMPTOMS are those of pyelitis. The urine may be purulent for years, and there may be little or no distress. Even before the bladder becomes involved micturition is frequent, and many instances are mistaken for cystitis. The frequent micturition is in part due to an initial polyuria, in part to reflex irritation, but chiefly to a non-tuberculous inflammation over the trigone of the bladder. It is usually the earliest and most constant symptom. Hæmaturia, of a mild grade, occurs at some time during the course ~~of the disease~~ in the majority of ~~the~~ cases. Dull, aching pain in the lumbar region on one side is frequently complained of and may be the first symptom. The condition is for many years compatible with fair health. The curability is shown by the accidental discovery of the so-called scrofulous kidney, converted into cysts containing a putty-like substance. In cases in which the disease becomes advanced and both organs are affected constitutional symptoms are more marked. There is irregular fever, with chills and loss of weight and strength. General tuberculosis is common. In only one of my cases were the lungs uninvolved. In a case at the Montreal General Hospital a cyst perforated and caused fatal peritonitis.

Physical examination may detect special tenderness on one side, or the

Tubercle B. in urine. (L. Brown. J. of Med. Mar. 1913)

Diag from ordinary - very difficult by stain &c = result better. culture of t.b. much more rapid - inoculation only sure if positive.

Ref. urine when any unusual deposit. Maybe "blood" of t.b.

In gen. no trouble. if pelvis is descending. but if ureter tubercular has followed tubercle wandering round until it enters ureter passing down back.

Bact. in urine in pul. tub - new disease of kidney

" " - in many of cases of "

Digitized by the Internet Archive in 2015

The appearance of the urine of
in cystinuria case.

Fr: nephrectomy [illegible] by tuberculosis

Barney - J.A.Med. 1914. 63. h 2274.

treated a sem. res. in 759 cases.

epididymis - metastasis

kidney may be palpable in front on deep pressure; but tuberculous pyelonephritis seldom causes a large tumor. Occasionally the pelvis becomes enormously distended; but this is rare in comparison with its frequency in calculous pyelitis. The urine presents changes similar to those of ordinary calculous pyelitis—pus-cells, epithelium, and occasionally definite caseous masses. It is nearly always acid in reaction. Albumin is present, Tubercle bacilli may be demonstrated. Tube-casts are not often seen.

DIAGNOSIS.—To distinguish the condition from calculous pyelitis is often difficult. Hæmorrhage may be present in both, though not nearly so frequently in the tuberculous disease. Functional hæmaturia, to which Senator has given the name *essential renal hæmaturia*, and Klemperer that of *angioneurotic renal hæmaturia*, has been a source of error in diagnosis and has led to surgical interference. In this condition it is highly probable that bleeding from the kidney can occur in the absence of any definite lesion of the organ, although Israel denies the existence of such an anomaly. The subcutaneous injection of phenolsulphonephthalein is of value in determining the kidney affected and its functional capacity. The diagnosis rests on three points: (1) The detection of some focus of tuberculosis, as in the testis; (2) the presence of tubercle bacilli in the sediment; and (3) the use of tuberculin. The kidney involved is easily determined by catheterizing the ureters.

Tuberculosis of the suprarenal capsules will be considered under Addison's Disease.

Tuberculosis of the Ureter and Bladder.—This rarely occurs as a primary affection, but is nearly always secondary to involvement of other parts, particularly the pelvis of the kidney.

Protracted cystitis which has come on without apparent cause is always suggestive of tuberculosis. The renal regions, the testes, and the prostate should be examined with care. It may follow a pyelo-nephritis, or be associated with primary disease of the prostate or vesiculæ seminales. Primary tuberculosis of the posterior wall of the bladder may simulate stone.

Tuberculosis of the Prostate and Vesiculæ Seminales.—The prostate is frequently involved in tuberculosis of the uro-genital tract. In Krzyincki's cases, of 15 males the prostate was involved in 14 and the vesiculæ seminales in 11. In Orth's cases the prostate was involved in 18 of the 37 cases in males. These parts are much more frequently involved than ordinary post-mortem statistics indicate. *Per rectum* the prostatic lobes are felt to be occupied by hard nodules varying in size from a pea to a bean. There is great irritability of the bladder, and agonizing pain in catheterization. An extremely rare lesion is primary urethral tuberculosis, which may simulate stricture.

Tuberculosis of the Testes.—This somewhat common affection may be primary, or, more frequently, is secondary to tuberculous disease elsewhere. Many cases occur before the second year, and it is stated to have been met with in the fetus. In infants it is serious and usually associated with tuberculous disease in other parts. In 9 cases reported by Hutinel and Deschamps,

in every one there was a general affection. In 20 cases reported by Jullien, 6 were under one year, and 6 between one and two years old. In 5 of the cases both testicles were affected. Koplik holds that most of the instances of this kind are congenital, in Baumgarten's sense. In the adult the tubercles begin within the substance of the gland, but in children the tunica albuginea is first affected. The tubercle does not always undergo caseation, but it may present a number of embryonic cells, not unlike a sarcoma.

Tubercle of the testes is most likely to be confounded with syphilis. In the latter the body of the organ is most often affected, there is less pain, and the outlines of the growth are more nodular and irregular. In obscure peritoneal disease the detection of tubercle in a testis has not infrequently led to a correct diagnosis. The association of the two conditions is not uncommon. The lesion in the testis may heal completely, or the disease may become generalized. General infection has followed operation. Too much stress can not be laid on the importance of a routine examination of the testes.

Tuberculosis of the Fallopian Tubes, Ovaries, and Uterus.—The *Fallopian tubes* are by far the most frequent seat of genital tuberculosis. The disease may be primary and produce a most characteristic form of salpingitis, in which the tubes are enlarged, the walls thickened and infiltrated, and the contents cheesy. Adhesion takes place between the fimbriæ and the ovaries, or the uterus may be invaded. The condition is usually bilateral. It may occur in young children. Although, as a rule, very evident to the naked eye, there are specimens resembling ordinary salpingitis, which show on microscopic examination numerous miliary tubercles (Welch and Williams). Tuberculous salpingitis may cause serious local disease with abscess formation, and it may be the starting-point of peritonitis.

Tuberculosis of the *ovary* is always secondary. There may be an eruption of tubercles over the surface in an extensive involvement of the stroma with abscess formation.

Tuberculosis of the *uterus* is very rare. Only three examples have come under my observation, all in connection with pulmonary phthisis. It may be primary. The mucosa of the fundus is thickened and caseous, and tubercles may be seen in the muscular tissue. Occasionally the process extends to the vagina.

Tuberculosis of the *placenta* is more common than has been supposed. Of 20 placentas from tuberculous women, 9 were affected; 5 of these were from cases of advanced disease of the lung. The lesions are easily overlooked.

IX. TUBERCULOSIS OF THE MAMMARY GLAND

Mandry (Bruns's Beiträge, viii) has collected 40 cases, 1 of which was in a male. The disease is most common between the fortieth and sixtieth years. The breast is frequently fistulous, unevenly indurated, and the nipple is retracted. The fistulæ and ulcers present a characteristic tuberculous aspect. There is also a cold tuberculous abscess of the breast. The axillary glands are affected in about two-thirds of the cases. The disease runs a chronic course of months or years. The diagnosis can be made by the general appearance of the fistulæ and ulcers, and by the existence of tubercle bacilli. The prognosis is not serious, if total eradication of the disease be possible.

Genève, 11 avril

In 1836 Bedor described an hypertrophy of the breast in the subjects of pulmonary tuberculosis. As a rule, if one gland is involved, usually on the side of the affected lung, as already mentioned, the condition is one of chronic interstitial mammitis, and is not tuberculous.

X. TUBERCULOSIS OF THE CIRCULATORY SYSTEM

Myocardium.—Scattered miliary tubercles are sometimes met with in the acute disease. Larger caseous tubercles are excessively rare. A. Moser found 46 cases on record. There is also a sclerotic tuberculous myocarditis. The infection often passes from a mediastinal gland.

Endocardium.—In 216 autopsies in cases of chronic phthisis I found endocarditis in 12. It was present in only 151 among more than 11,000 autopsies on tuberculous cases (G. W. Norris). As a rule, it is a secondary form, the result of a mixed infection, so common in pulmonary tuberculosis. A true tuberculous endocarditis does, however, occur, directly dependent upon infection with the bacillus of Koch. As a rule, it is a vegetative endocarditis, not to be distinguished from that caused by a streptococcus or staphylococcus. In rare cases, however, caseous tubercles develop.

Arteries.—Primary tuberculosis of the larger blood-vessels is very rare, and is usually the result of invasion from without. The disease may, however, occur in a large artery and not result from external invasion. In a case of chronic tuberculosis Flexner found a fresh tuberculous growth in the aorta, which had no connection with cheesy masses outside the vessel. Simmitsky has collected 18 cases of tuberculosis of the aorta.

In the lungs and other organs attacked by tuberculosis the *arteries* are involved in an acute infiltration which usually leads to thrombosis, or tubercles may develop in the walls and proceed to caseation and softening, frequently with a resulting hæmorrhage. By extension into vessels, particularly veins, the bacilli are widely distributed with the production of miliary tuberculosis.

XI. THE PROGNOSIS IN TUBERCULOSIS

The parable of the sower already referred to expresses better than in any other way the question of individual predisposition. There are five groups of cases of tuberculous infection. 1. Those who become infected and recover spontaneously without knowing they have been infected. 2. Mild infections which produce slight symptoms, recovery following after a few months of change of air or special treatment. 3. Cases with well-marked signs of lung disease in which thorough treatment is followed by complete recovery. 4. Cases with extensive local disease and cavity formation in which arrest takes place and the patients live for many years. 5. The cases in which the infection is of such a type that death follows no matter what is done. The late Austin Flint, *facile princeps* among American students of the disease, called attention to the self-limitation and intrinsic tendency to recovery in pulmonary tuberculosis. This natural tendency to cure is still more strikingly shown in lymphatic and bone tuberculosis.

The following may be considered favorable circumstances in the prognosis of pulmonary tuberculosis: An early diagnosis, a good family history, previous good health, a strong digestion, a suitable environment, and an insidious

onset, without high fever, and without extensive pneumonic consolidation. Cases beginning with pleurisy seem to run a more protracted and more favorable course. Repeated attacks of hæmoptysis are unfavorable. When well established the course of tuberculosis in any organ is marked by intervals of weeks or months in which the fever lessens, the symptoms subside, and there is improvement in the general health.

In pulmonary cases the duration is extremely variable. Laennec placed the average duration at two years, and for the majority of cases this is perhaps a correct estimate. Pollock's large statistics of over 3,500 cases show a mean duration of the disease of over two years and a half. Williams's analysis of 1,000 cases in private practice shows a much more protracted course, as the average duration was over seven years.

Tuberculosis and Marriage.—Under the subject of prognosis comes the question of the marriage of persons who have had tuberculosis, or in whose family the disease prevails. The following brief statements may be made with reference to it:

(*a*) Subjects with healed lymphatic or bone tuberculosis marry with personal impunity and may beget healthy children. It is undeniable, however, that in such families scrofula, caries of the bone, arthritis, cerebral and pulmonary tuberculosis are more common. The risks, however, are such as may properly be taken.

(*b*) The question of marriage of a person who has arrested or cured lung tuberculosis is more difficult to decide. In a male the personal risk is not so great; and when the health and strength are good, the external environment favorable, and the family history not extremely bad, the experiment—for it is such—is often successful, and many healthy and happy families are begotten under these circumstances. In women the question is complicated with that of child-bearing, which increases the risks enormously. With a localized lesion, absence of hereditary taint, good physique, and favorable environment marriage might be permitted. When tuberculosis has existed, however, in a girl whose family history is bad, whose chest expansion is slight, and whose physique is below the standard, the physician should, if possible, place his veto upon marriage.

(*c*) With existing disease, fever, bacilli, etc., marriage should be prohibited. Pregnancy usually hastens the process, though it may be held in abeyance. After parturition the disease advances rapidly. There is much truth, indeed, in the remark of Dubois: "If a woman threatened with phthisis marries, she may bear the first accouchement well; a second, with difficulty; a third, never." Conception may occur in an advanced stage of the disease.

XII. PROPHYLAXIS IN TUBERCULOSIS

General.—Among the more important measures may be mentioned the following: *First,* education of the public. Much has been done in this direction by the antituberculosis crusade, which has resulted in the formation of many active societies, and has stimulated widespread interest in the disease. *Secondly,* the placing of pulmonary tuberculosis on the list of reportable diseases. This gives the board of health control of the situation, and, as the New York experience has demonstrated, is perhaps the most helpful measure

in the prophylaxis. *Thirdly*, the improved sanitary condition of the poor, particularly with reference to the housing. *Fourthly*, direct preventive measures, such as the enactment of laws against spitting in public, the proper disinfection and cleaning of the rooms and houses which have been occupied by tuberculous patients, and the careful inspection of dairies and abattoirs. *Fifthly*, in the large cities, *organization* of sanatoria and hospitals for early curable and late incurable cases, and the establishment of separate dispensaries with a system of visiting the patients at their homes by specially assigned nurses. *Lastly*, the care of the sputum of the consumptive. Thorough boiling or putting it into the fire is sufficient. In hospitals it is well to have printed directions as to the care of the sputum, and also printed cards for out-patients, giving the most important rules. It should be explained to the patient that the only risk, practically, is from this source.

Individual.—Individual prophylaxis in the case of delicate children is most important. An infant born of tuberculous parents, or of a family in which consumption prevails, should be brought up with the greatest care and guarded most particularly against catarrhal affections of all kinds. Special attention should be given to the throat and nose, and on the first indication of mouth-breathing, or any obstruction of the naso-pharynx, a careful examination should be made for adenoid vegetations. The child should be clad in flannel and live in the open air as much as possible, avoiding close rooms. It is a good practice to sponge the throat and chest night and morning with cold water. Special attention should be paid to diet and to the mode of feeding. The meals should be at regular hours and the food plain and substantial. From the outset the child should be encouraged to drink freely of milk. Unfortunately, in these cases there seems to be an uncontrollable aversion to fats of all kinds. As the child grows older, systematically regulated exercise or a course of pulmonary gymnastics may be taken. In the choice of an occupation preference should be given to an out-of-door life. Families with a marked predisposition to tuberculosis should, if possible, reside in an equable climate. The possibility of a protective inoculation has been shown by the experiments of Webb and Williams, as monkeys so protected can be exposed successfully in situations favorable to infection. ~~It is stated that the method has been used with success in children~~.

The trifling ailments of children should be carefully watched. In the convalescence from the fevers which so frequently prove dangerous the greatest caution should be exercised to prevent catching cold. Cod-liver oil, the syrup of the iodide of iron, and arsenic may be given. As mentioned, care of the throat in these children is very important. Enlarged tonsils should be removed.

XIII. TREATMENT OF TUBERCULOSIS

The Natural or Spontaneous Cure.—The spontaneous healing of local tuberculosis is an every-day affair. A majority of those infected never have the disease, *i. e.*, they recover without symptoms, without the slight lesion having disturbed the health. Many cases of adenitis and disease of the bone or of the joints terminate favorably. The healing of pulmonary tuberculosis is shown clinically by the recovery of patients in whose sputum elastic tissue and bacilli have been found; anatomically, by the presence of lesions in all

stages of repair. In the granulation products and associated pneumonia a scar-tissue is formed, while the smaller caseous areas become impregnated with lime salts. To such conditions alone should the term healing be applied. When the fibroid change encapsulates but does not involve the entire tuberculous tissue, the tubercle may be termed involuted or quiescent, but is not destroyed. When cavities of any size have formed, healing, in the proper sense of the term, does not occur. I have yet to see a specimen which would indicate that a vomica had cicatrized. Cavities may be greatly reduced in size—indeed, an entire series of them may be so contracted by sclerosis of the tissue about them that an upper lobe, in which this process most frequently occurs, may be reduced to a third of its ordinary dimensions. Laennec understood thoroughly this natural process of cure in tuberculosis, and recognized the frequency with which old tuberculous lesions occurred in the lungs. He described *cicatrices complètes* and *cicatrices fistuleuses*, the latter being the shrunken cavities communicating with the bronchi; and remarked that, as tubercles growing in the glands, which are called scrofula, often heal, why should not the same take place in the lungs?

There is an old German axiom, *"Jedermann hat am Ende ein bischen Tuberculose,"* a statement partly borne out by the statistics showing the proportions of cases in persons dying of all disease in whom quiescent or tuberculous lesions are found in the lungs. We find at the apices the following conditions, which have been held to signify healed tuberculous processes: (*a*) Thickening of the pleura, usually at the posterior surface of the apex, with subadjacent induration for a distance of a few millimetres. This has, perhaps, no greater significance than the milky patch on the pericardium. (*b*) Puckered cicatrices at the apex, depressing the pleura, and on section showing a large pigmented, fibrous scar. The bronchioles in the neighborhood may be dilated, but there are neither tubercles nor cheesy masses. This may sometimes, but not always, indicate a healed tuberculous lesion. (*c*) Puckered cicatrices with cheesy or cretaceous nodules, and with scattered tubercles in the vicinity. (*d*) The *cicatrices fistuleuses* of Laennec, in which the fibroid puckering has reduced the size of one or more cavities which communicate directly with the bronchi.

General Measures.—The cure of tuberculosis is a question of nutrition; digestion and assimilation control the situation; as a rule, make a patient grow fat and strong, and the local disease may be left to take care of itself. There are three indications: First, to place the patient in surroundings most favorable for the maintenance of a maximum degree of nutrition; second, to take such measures as, in a local or general way, influence the tuberculous processes; third, to alleviate symptoms.

Open-air Treatment.—The value of fresh air and out-of-door life is well illustrated by an experiment of Trudeau. Inoculated rabbits confined in a dark, damp place rapidly succumbed, while others, allowed to run wild, either recovered or show slight lesions. It is the same in human tuberculosis. A patient confined to the house—particularly in the close, overheated, stuffy dwellings of the poor, or treated in a hospital ward—is in a position analogous to that of the rabbit confined to a hutch in the cellar; whereas a patient living in the fresh air and sunshine for the greater part of the day has chances comparable to those of the rabbit running wild.

The open-air treatment of tuberculosis may be carried out at home, by change of residence to a suitable climate, or in a sanatorium.

(*a*) *At Home.*—In a majority of all cases the patient has to be cared for in his own home, and, if in the city, under very disadvantageous circumstances. Much, however, may be done even in cities to promote arrest by insisting upon systematic treatment. How much may be done by care and instruction is shown by the success of J. H. Pratt's *tuberculosis classes.* As not five per cent. of the patients can be dealt with in sanatoria, it is surprising and gratifying to see how successful the home treatment may be. Even in cities the patients may be trained to sleep out of doors, and the results obtained by Pratt, Millett, and others are as good as any that have been published. *While there is fever the patient should be at rest in bed,* and night and day the windows should be open, so that he may be exposed freely to the fresh air. Low temperature is not a contra-indication. If there is a balcony or a suitable yard or garden, on the brighter days the patient may be wrapped up and put in a reclining chair or on a sofa. The important thing is for the physician to emphasize the fact that neither the cough, fever, night sweats, and not even hæmoptysis contra-indicate a full exposure to the fresh air. In country places this can be carried out much more effectively. In the summer the patient should be out of doors for at least eleven or twelve hours, and in winter six or eight hours. At night the room should be cool and thoroughly well ventilated. It may require several months of this rest treatment in the open air before the temperature falls to normal.

(*b*) *Treatment in Sanatoria.*—Perhaps the most important advance in the treatment of tuberculosis has been in the establishment ~~in favorable localities~~ of institutions in which patients are made to live according to strict rules. To Brehmer, of Göbersdorf, we owe the successful execution of this plan, which has been followed in Germany with most gratifying results. In the United States the zeal, energy, and scientific devotion of Edward L. Trudeau ~~have~~ demonstrated its feasibility, and the Saranac institution has become a model of its kind. The results at hundreds of institutions demonstrate the great importance of system and rigid discipline in carrying out a successful treatment, ~~of tuberculosis~~. Much has been done ~~in the United States, Great Britain and the Continent~~ to promote the sanatorium treatment of tuberculosis. ~~The past ten years have been rich in experience.~~ The good results have quite justified the heavy expenditure of money. In many places it has been demonstrated that with an inexpensive plant excellent results may be obtained. A reaction has naturally followed the "stuffing" plan of feeding, and more reasonable methods are now employed. The "absolute rest" plan has been modified to meet individual cases. The all-important matter is the establishment near to the large cities of public sanatoria for the treatment of cases in the early stages. There should be opened in the large general hospitals (special out-patient departments for tuberculous patients) from which suitable cases could be sent to the sanatoria. Much discussion has taken place as to the result of sanatorium treatment. Personally I am stongly convinced of its extraordinary benefits in suitable cases. To pay a visit with Dr. Bardwell to the King Edward Sanatorium at Midhurst and see nearly every one of 100 early ~~cases~~ looking in good condition with fresh air, judicious rest, proper exercise and diet, without drugs and without tuberculin, im-

presses one immensely with the value of the method. Statistics are notoriously uncertain, but there is perhaps no institution of the English-speaking world in which greater care has been taken to trace the after-history of the patients than at the Adirondack Sanatorium, ~~founded by Dr. Trudeau~~. The total number of patients from the years 1885 to 1909 inclusive was 2,878. It has been impossible to trace 206 of these. Of the remaining 2,672, 1,512 were living (1911) and 1,160 dead.

(*c*) *Climatic Treatment.*—This, after all, is only a modification of the open-air method. The first question to be decided is whether the patient is fit to be sent from home. In many instances it is a positive hardship. A patient with well-marked cavities, hectic fever, night sweats, and emaciation is much better at home, and the physician should not be too much influenced by the importunities of the sick man or his friends. The requirements of a suitable climate are a *pure atmosphere,* an *equable temperature* not subject to rapid variations, and a *maximum amount of sunshine.* Given these three factors, it makes little difference *where* a patient goes, so long as he lives *an outdoor life.* Major Woodruff believes that sunshine may be hurtful, and he has collected statistics to show that tuberculosis is more prevalent and more fatal among the dark races, who live where the sun shines the brightest. The point is one of interest, but I do not think the case against the sun is made out. The different climates may be grouped into the high altitudes, the dry, warm climates, and the moist, warm climates. Among high altitudes in the United States, the Colorado resorts are the most important. Of others, those in Arizona and New Mexico have been growing rapidly. The rarefaction of the air in high altitudes is of benefit in increasing the respiratory movements ~~in pulmonary disease~~, but brings about in time a condition of dilatation of the air-vesicles and a permanent increase in the size of the chest which is a marked disadvantage when such persons attempt subsequently to reside at the sea-level. The great advantage of these western resorts is that they are in progressive, prosperous countries, in which a man may find means of livelihood and live in comfort. In Europe the chief resorts at high altitudes are Davos, Les Avants, and St. Moritz. Of resorts at a moderate altitude, Asheville and the Adirondacks are the best known in America. The Adirondack cure has become of late years quite famous. One very decided advantage is that after arrest of the disease the patient can return to the sea-level without any special risk. The cases most suitable for high altitudes are those in which the disease is limited, without much cavity formation, and without much emaciation. The thin, irritable patients with chronic tuberculosis and a good deal of emphysema are better at the sea-level. The cold winter climate seems to be of decided advantage in tuberculosis, and in the Adirondacks, where the temperature falls sometimes to 20° or even more below zero, the patients are able to lead an out-of-door life throughout the entire winter.

Of the moist, warm climates, in America Florida and the Bermudas, in Europe the Madeira Islands, and in Great Britain Eastbourne, Bournemouth, Torquay, and Falmouth are the best known. Of the dry, warm climates, Southern California in the United States is the most satisfactory. Many of the health resorts in the Southern States, such as Aiken, Thomasville, and Summerville, are delightful winter climates for tuberculous cases. Egypt,

Algiers, and the Riviera are the most satisfactory resorts for patients from Europe.

Other considerations which should influence the choice of a locality are good accommodations and good food. It is also important to be under the care of a competent physician. Very much is said concerning the choice of locality in the different stages of pulmonary tuberculosis, but when the disease is limited to an apex, in a man of fairly good personal and family history, the chances are that he may fight a winning battle if he lives out of doors in any climate, whether high, dry, and cold, or low, moist, and warm. With bilateral disease and cavity formation there is but little hope of permanent cure, and the mild or warm climates are preferable.

Measures which, by their Local or General Action, Influence the Tuberculous Process.—Under this heading we may consider the specific, the dietetic, and the general medicinal treatment of tuberculosis.

(*a*) SPECIFIC TREATMENT.—Introduced by Koch in 1890, the tuberculin treatment soon fell into disfavor, but, in spite of the bad results that naturally followed its injudicious use, certain men (among them, particularly, Trudeau) continued to use it. Of late years there has been a reaction in its favor, and now tuberculin is again lauded by some fanatics as the one and only means of cure in the disease. Unquestionably in suitable cases it has a very beneficial influence; the difficulty is to decide which they are. At present so indiscriminate is its use that an estimation of the results is very difficult. The preliminary question arises as to what justifies the diagnosis of tuberculosis, and it is impossible to compare the results obtained by different observers. Anybody, by any method, can secure 100 per cent. of cures in the so-called "closed" pulmonary tuberculosis. As Hamman states very sensibly: "If in the case of every patient who presents himself for examination and shows some trifling deviation from the normal physical signs a diagnosis of tuberculosis is made, or if tuberculin is made the ultimate test of a correct diagnosis, similar results may be obtained with any or with no method." A variety of preparations come under the name Tuberculin: O. T. and T. R., which are Koch's old and new preparations; Deny's tuberculin, *bouillon filtré*, known as B. F., and a bacillary emulsion of Koch, B. E. ~~If given in accordance with Wright's instructions,~~ the smallest dose which will bring out a response should be used, 1/2000 or 1/1000 mgm. and re-inoculations are made at intervals of from one to two weeks. ~~If the tuberculo-opsonic index rises, it is taken as an indication that the injections are helpful, and the amount is gradually increased when it is found that the dose previously given~~ ceases to bring out a sufficient response. It is administered to afebrile patients. It is no longer thought desirable—quite the contrary, in fact—to get a severe general reaction, particularly as this may be associated with marked focal reactions. The aim striven for is to get as high a grade of tuberculin tolerance as possible. Trudeau, who ~~has~~ had probably the longest individual experience of anyone ~~at present~~ using tuberculin, begins with doses so small that no reaction is produced; then the dose is cautiously raised, avoiding the slightest reaction. On the other hand, Wilkinson begins with a very high dose, and uses the tuberculin in a much wider range of cases.

(*b*) DIETETIC TREATMENT.—The outlook in tuberculosis depends much upon the digestion. It is rare to see recovery in a patient in whom there is

persistent gastric trouble, and the physician should ever bear in mind the fact that in this disease the *primæ viæ* control the position. The early nausea and loss of appetite in many cases are serious obstacles. Many patients loathe food of all kinds. A change of air or a sea voyage may promptly restore the appetite. When either of these is impossible, and if, as is almost always the case, fever is present, the patient should be placed at rest, kept in the open air nearly all day, and fed at stated intervals with small quantities either of milk, buttermilk, or koumyss, alternating if necessary with meat juice and egg albumin. Some patients who are disturbed by eggs and milk do well on koumyss. It may be necessary to resort to Débove's method of over-alimentation or forced feeding. The stomach is first washed out with cold water, and then, through the tube, a mixture is given containing a litre of milk, an egg, and 100 grams of very finely powdered meat. This is given three times a day. Sometimes the patients will take this mixture without the unpleasant necessity of the stomach-tube, in which case a smaller amount may be given. Raw eggs are very suitable for the purpose of over-feeding, and may be taken in the intervals between the meals. Beginning with one three times a day the number may be increased to two, three, or even four at a time. In the German sanatoria a very special feature is this over-feeding, even when fever is present. R. W. Philip advises a raw meat diet—zomotherapy—half a pound three times a day, either minced or as a soup.

In many cases the digestion is not at all disturbed and the patient can take an ordinary diet. It is remarkable how rapidly the appetite and digestion improve with the fresh-air treatment, even in patients who have to remain in the city. Care should be taken that the medicines do not disturb the stomach. Not infrequently the sweet syrups used in the cough mixtures, cod-liver oil, creosote, and the hypophosphites produce irritation, and by interfering with digestion do more harm than good. On the other hand, the bitter tonics, with acids, and the various malt preparations are often most satisfactory. The indications for alcohol in tuberculosis are enfeebled digestion with fever, a weak heart, and rapid pulse. A routine administration is not advisable, and there is no evidence that its persistent use promotes fibroid processes in the tuberculous areas. In the advanced stages, particularly when the temperature is low between eight and ten in the morning, whisky and milk, or whisky, egg, and milk may be given with ~~great~~ advantage. ~~The red wines are also beneficial in moderate quantities.~~

(*c*) Exercise.—It is found as a rule that the patient with fever does best at absolute rest, and that exercise should only be taken after an afebrile period, and then very gradually. It has long been known that following exercise the temperature is raised, and Paterson, of Frimly, has adopted a method of graded exercises which have yielded excellent results. The plan is based upon the view that physical exercise induces auto-inoculation, the extent of which may be controlled by the amount of muscular effort. By a study of the fever-chart, the body weight, the amount of sputum, and the appetite the rate of progress may be estimated. The febrile patient is regarded as one in whom the auto-inoculation is excessive. To overcome this the patient is immobilized in bed so far as possible, and not allowed to make any movements whatever. The effect of this is often remarkable in reducing the fever. Once afebrile, the principal element in the treatment

is the induction of an auto-inoculation by exercises, which Paterson believes have very much the same effect as a dose of tuberculin. A scheme of graded labor has been devised, which has many advantages in sanatorium life, and the results obtained at Frimly are certainly very gratifying.

(*d*) IMMOBILIZING THE LUNG BY INDUCTION OF PNEUMOTHORAX.—Years ago Cayley induced pneumothorax in a case of hæmoptysis. The method never came into general use; but, on the principle of keeping an inflamed organ at rest, this method has been advocated in pulmonary tuberculosis by Forlanini and by J. B. Murphy. Sterile nitrogen is introduced into the pleural cavity through a thin, hollow needle. It is best to use a special apparatus with a water-manometer, so that measured quantities may be injected. At first from 200 to 300 c. c.; later as much as 500 c. c. are introduced, at intervals of a day or every other day, until the lung is completely collapsed, and until there is a positive interpleural pressure of from 5 to 10 cm. of water. The method has been widely practiced ~~in America and on the Continent~~, with excellent results, it is claimed, in certain cases; but there are dangers, as hæmoptysis, serous effusion, and empyema, and a serious objection is the duration of the treatment, as the pleural cavity requires to be refilled every month or two.

(*e*) GENERAL MEDICAL TREATMENT.—No medicinal agents have any special or peculiar action upon tuberculous processes. The influence which they exert is upon the general nutrition, increasing the physiological resistance, and rendering the tissues less susceptible to invasion. The following are the most important remedies which seem to act in this manner:

Creosote, which may be administered in capsules, in increasing doses, beginning with 1 minim three times a day and, if well borne, increasing the dose to 8 or 10 minims. It may also be given in solution with tincture of cardamon and alcohol. It is an old remedy, strongly recommended by Addison, and the reports of Jaccoud, Fraentzel, and many others show that it has a positive value ~~in the disease~~. It may be used as an inhalation. Guaiacol may be given as a substitute, either internally or hypodermically.

Cod-liver Oil.—In glandular and bone tuberculosis this remedy is undoubtedly beneficial in improving the nutrition. In pulmonary tuberculosis its action is less certain, and it is scarcely worthy of the unbounded confidence which it enjoyed for so many years. It should be given in small doses, not more than a teaspoonful three times a day after meals. It seems to act better in children than in adults. Fever and gastric irritation are contra-indications to its use. ~~When it is not well borne~~, a dessertspoonful of rich cream three times a day is an excellent substitute. The clotted or Devonshire cream is preferable.

The Hypophosphites.—These in various forms are useful tonics, but it is doubtful if they have any other action. They certainly exercise no specific influence upon tubercle.

Arsenic.—There is no general tonic more satisfactory in cases of tuberculosis of all kinds than Fowler's solution. It may be given in 5-minim doses three times a day and gradually increased; stopping its use whenever unpleasant symptoms arise, and in any case intermitting it every third or fourth week. Recently intramuscular injections of the salts of cacodylic acid have

been used to combat the anæmia so commonly present in tuberculous infections with, it is claimed, unusual success.

Treatment by compressed air is in many cases beneficial, and under its use the appetite improves, there is gain in weight and reduction of the fever. The air may be saturated with creosote.

Treatment of Special Symptoms in Pulmonary Tuberculosis.—(*a*) THE FEVER.—There is no more difficult problem in practical therapeutics than the treatment of the pyrexia of tuberculosis. The patient should be at absolute rest, and *in the open air night and day for some weeks.* Fever does not contra-indicate an out-of-door life, but it is well for patients with a temperature above 100.5° F. to be at rest. For the continuous pyrexia or the remittent type of the early stages, quinine, ~~small doses of digitalis~~, and the salicylates may be tried; but they are uncertain and rarely reliable. In large doses quinine has a moderate antipyretic action, but it is just in these efficient doses that it is so apt to disturb the stomach.

Antipyrin and antifebrin may be used cautiously; but it is better, when the fever rises above 103° F. to rely upon cold sponging or the tepid bath, gradually cooled. When softening has taken place and the fever assumes the characteristic septic type, the problem becomes still more difficult. As shown by Chart V (which is not by any means an exceptional one), the pyrexia, at this stage, lasts only for twelve or fifteen hours. As a rule there are not more than from eight to ten hours in which the fever is high enough to demand antipyretic treatment. Sometimes antifebrin, given in 2-grain doses every hour for three or four hours before the rise in temperature takes place, either prevents entirely or limits the paroxysm. If the temperature begins to rise between two and three in the afternoon, the antifebrin may be given at eleven, twelve, one, and, if necessary, at two. It answers better in this way than given in the single doses. Careful sponging of the extremities for from half an hour to an hour during the height of the fever is useful. Quinine is of little benefit in this type of fever; the salicylates are of still less use.

(*b*) SWEATING.—Atropine, in doses of gr. $\frac{1}{120}$-$\frac{1}{60}$, and the aromatic sulphuric acid in large doses are the best remedies. When there are cough and nocturnal restlessness, an eighth of a grain of morphia may be given with the atropine. Muscarin (♏ v of a 1-per-cent solution), tincture of nux vomica (♏ xxx, 2 c. c.), picrotoxin (gr. $\frac{1}{60}$) may be tried. The patient should use light flannel night-dresses, as the cotton night-shirts, when soaked with perspiration, have a very unpleasant cold, clammy feeling.

(*c*) COUGH.—The *cough* is a troublesome, though necessary, feature in pulmonary tuberculosis. Unless very worrying and disturbing sleep at night, or so severe as to produce vomiting, it is not well to attempt to restrict it. When irritative and bronchial in character, inhalations are useful, particularly the tincture of benzoin or preparations of tar, creosote, or turpentine. The throat should be carefully examined, as some of the most irritable and distressing forms of cough ~~in phthisis~~ result from laryngeal erosions. The distressing nocturnal cough, which begin just as the patient gets into bed and is preparing to fall asleep, requires, as a rule, preparations of opium. Codeia, in quarter- or half-grain doses may be given. An excellent combination for the nocturnal cough of phthisis is morphia (gr. $\frac{1}{8}$-$\frac{1}{6}$), dilute hydrocyanic acid (♏ ij-iij), and syrup of wild cherry (℥ j). The spirits of chloroform, B. P.,

su Brun-

Kidney. auth. 219.

or a mixture of chloroform and sedatives or Hoffman's anodyne, given in whisky before going to sleep, are efficacious. Mild counter-irritation, or the application of a hot poultice, will sometimes promptly relieve the cough. The morning cough is often much relieved by taking immediately after getting up a glass of hot milk or a cup of hot water, to which 15 grains of bicarbonate of soda have been added. In the later stages, ~~of the disease,~~ when cavities have formed, the accumulated secretion must be expectorated and the paroxysms of coughing are now most exhausting. The sedatives, such as morphia and hydrocyanic acid, should be given cautiously. The aromatic spirit of ammonia in full doses helps to allay the paroxysm. When the expectoration is profuse, creosote internally, or inhalations of turpentine and iodine, or oil of eucalyptus, are useful. For the troublesome dysphagia a strong solution of cocaine (gr. x, 0.6 gm.) with boric acid (gr. v, 0.3 gm.) in glycerine and water (℥ j, 30 c.c.) may be used locally.

(*d*) Diarrhœa.—For the diarrhœa large doses of bismuth, combined with Dover's powder, and small starch enemata, with or without opium, may be given. The acetate of lead and opium pill often acts promptly, and the acid diarrhœa mixture, dilute acetic acid (♏ x-xv, 1 c.c.), morphia (gr. ⅛, 0.008 gm.), and acetate of lead (gr. j-ij, 0.1 gm.), may be tried.

(*e*) The treatment of the hæmoptysis will be considered in the section on hæmorrhage from the lungs. Dyspnœa is rarely a prominent symptom except in the advanced stages, when it may be very troublesome and distressing. Ammonia and morphia, cautiously administered, may be used.

If the pleuritic pains are severe, the side may be strapped, or painted with tincture of iodine. The dyspeptic symptoms require careful treatment, as the outlook in individual cases depends much upon the condition of the stomach. Small doses of calomel and soda often allay the distressing nausea ~~of the early stage~~.

A last word on the subject of tuberculosis to the general practitioner. *The leadership of the battle against this scourge is in your hands. Much has been done, much remains to do. By early diagnosis and prompt, systematic treatment of individual cases, by striving in every possible way to improve the social condition of the poor, by joining actively in the work of the local and national antituberculosis societies you can help in the most important and the most hopeful campaign ever undertaken by the profession.*

B. NON-BACTERIAL FUNGUS INFECTIONS—THE MYCOSES

Much attention has been paid ~~lately~~ to the local and general infections caused by the group of fungoid organisms variously classed as Streptothrix, Actinomyces, Cladothrix and Leptothrix. The French workers, ~~who have done so much lately,~~ group the various diseases caused by these organisms under the term Mycoses, which is a convenient and useful designation. Four or five of these diseases are of sufficient importance to be considered in a work of this scope.

I. ACTINOMYCOSIS

Definition.—A chronic infective disorder produced by the actinomyces or ray-fungus, *Streptothrix actinomyces.*

Etiology.—The disease is widespread among cattle, and occurs also in the pig. It was first described by Bollinger in the ox, in which it forms the affection known in America as "big-jaw." The first accurate description of the disease in man was given by James Israel, and subsequently Ponfick insisted upon the identity of the disease in man and cattle.

In the United States and England the disease is less common than in Germany. It is nearly three times as common in men as in women.

The *parasite* belongs probably to the *Streptothrix* group. In both man and cattle it can be seen in the pus from the affected region as yellowish or opaque granules from one-half to two millimetres in diameter, which are made up of cocci and radiating threads, presenting bulbous, club-like terminations. The youngest granules are gray in color and semi-translucent; in these the bulbous extremities are wanting.

The parasite has been successfully cultivated, and in a few instances the disease has been inoculated both with the natural and artificially grown organism.

The Mode of Infection.—There is no evidence of direct infection with the flesh or milk of diseased animals. The streptothrix has not been detected outside the body. It seems highly probable that it is taken in with the food. The site of infection in a majority of cases in man and animals is in the mouth or neighboring passages. In the cow, possibly also in man, barley, oats, and rye have been carriers of the germ.

Morbid Anatomy.—As in tubercle, the first effect is the destruction of adjacent cells and the attraction of leucocytes—later the surrounding cells begin to proliferate. After the tumor reaches a certain size there is great proliferation of the surrounding connective tissue, and the growth may, particularly in the jaw, look like, and was long mistaken for, osteo-sarcoma. Finally suppuration occurs, which in man, according to Israel, may be produced directly by the streptothrix itself.

Clinical Forms.—(*a*) Digestive Tract.—Israel is said to have found the fungus in the cavities of carious teeth. The jaw has been affected in a number of cases in man. The patient comes under observation with swelling of one side of the face, or with a chronic enlargement of the jaw which may simulate sarcoma.

The tongue has been involved in several cases, showing small growths, either primary or following disease of the jaw. In the intestines the disease may occur either as a primary or secondary affection. The most common seat is the region of the cæcum and appendix. An actinomycotic appendicitis has been described; primary actinomycosis of the large intestine with metastases has also been found. Ransom has found the actinomyces in the stools. Actinomycotic *peritonitis* due to infection through a gastrostomy wound has been described. Actinomycosis of the *liver* is rare. Auvray in 1903 could only collect 31 cases (Rolleston). It forms a most characteristic lesion, an alveolar honey-combed abscess—like a sponge soaked in pus. It

is usually secondary to an intestinal lesion, but in a few cases no other focus has been found.

(b) Pulmonary Actinomycosis.—In September, 1878, James Israel described a remarkable mycotic disease of the lungs, which subsequent observation showed to be the affection described the year before by Bollinger in cattle. Since that date many instances have been reported in which the lungs were affected. It is a chronic infectious pulmonary disorder, characterized by cough, fever, wasting, and a muco-purulent, sometimes fetid, expectoration. The lesions are unilateral in a majority of the cases. Hodenpyl classifies them in three groups: (1) Lesions of chronic bronchitis; the diagnosis has been made by the presence of the actinomyces in the sputum. (2) Miliary actinomycosis, closely resembling miliary tubercle, but the nodules are seen to be made up of groups of fungi, surrounded by granulation tissue. This form of pulmonary actinomycosis is not infrequent in oxen with advanced disease of the jaw or adjacent structures. (3) The cases in which there is more extensive destructive disease of the lungs, broncho-pneumonia, interstitial changes, and abscesses, the latter forming cavities large enough to be diagnosed during life. Actinomycotic lesions of other organs are often present in connection with the pulmonary disease; erosion of the vertebræ, necrosis of the ribs and sternum, with node-like formations, subcutaneous abscesses, and occasionally metastases in all parts of the body.

Symptoms.—The fever is of an irregular type and depends largely on the existence of suppuration. The cough is an important symptom, and the diagnosis in 18 of the cases was made during life by the discovery of the actinomyces. Death results usually with septic symptoms. Occasionally there is a condition simulating typhoid fever. The average duration of the disease was ten months. Recovery is not very rare. Clinically the disease closely resembles certain forms of pulmonary tuberculosis and of fetid bronchitis. It is not to be forgotten in the examination of the sputum that, as Bizzozero mentions, certain degenerated epithelial cells may be mistaken for the organism. The radiating leptothrix threads about the epithelium of the mouth sometimes present a striking resemblance.

(c) Cutaneous Actinomycosis.—In more than half of the recorded cases the disease has involved the skin of the head and neck; the buccal, lingual and pharyngeal structures may be involved also. It is a very chronic affection resembling tuberculosis of the skin, associated with the growth of tumors which suppurate and leave open sores, which may remain for years.

(d) Cerebral Actinomycosis.—Bollinger has reported an instance of primary disease of the brain. The symptoms were those of tumor. A second remarkable case has been reported by Gamgee and Delepine. The patient was admitted to St. George's Hospital with left-sided pleural effusion. At the post mortem three pints of purulent fluid were found in the left pleura; there was an actinomycotic abscess of the liver, and in the brain there were abscesses in the frontal, parietal, and temporo-sphenoidal lobes which contained the mycelium, but no clubs. A third case, reported by O. B. Keller, had *empyema necessitatis*, which was opened and actinomycetes were found in the pus. Subsequently she had Jacksonian epilepsy, for which she was trephined twice and abscesses opened, which contained actinomyces grains. Death occurred after the second operation.

Diagnosis.—The disease is in reality a chronic pyæmia. The only test is the presence of the actinomyces in the pus. Metastases may occur as in pyæmia and in tumors. The tendency, however, is rather to the production of a local purulent affection which erodes the bones and is very destructive.

Treatment.—This is largely surgical and is practically that of pyæmia. Incision of the abscess, removal of the dead tissue, and thorough irrigation are appropriate measures. Thomassen has recommended iodide of potassium, which, in doses of from 40 to 60 grains (2.5 to 4 gm.) daily, has proved curative in a number of recent cases. The X-rays have been very beneficial in the cutaneous forms.

II. THE SPOROTRICHOSES

Definition.—A chronic infection characterized by cutaneous and internal lesions due to the growth of various forms of parasitic fungi of the sporotrichosis group.

History.—In November, 1896, a patient presented himself at Finney's outpatient clinic at the Johns Hopkins Hospital with an infection of the right arm, which had lasted for several weeks. There were ulcerations on the hand and indurations on the forearm. The condition was recognized as unusual and Schenck, who undertook its study, found on culture a branched mycelium with numerous spores or conidia. Its identification was made by the well-known expert, Erwin F. Smith, and it has been named *Sporotrichum schenckii*. Since this publication, the disease has become widely recognized, owing chiefly to the studies of Beurmann and Gougerot, and it is now recognized that the disease is widely distributed and one of the most clearly defined of the mycoses.

The Parasite.—In the tissues and in the pus the parasite is a large short rod from 3 to 5 μ long and from 2 to 3 μ in breadth. In cultures it grows in filaments of about 2 μ in diameter and forms characteristic ovoid spores. The points of differentiation between the forms are due largely to variation in the modes of sporulation. The parasite is introduced chiefly by accidental inoculation, and possibly through grains and fruit. The fungi have an identical action with the pathogenic bacteria, producing toxins towards which there are active humoral reactions. Widal and Abrami determined the agglutinating and fixation properties of the serum in individuals affected, and specific reactions have been determined. There are minor differences between the form described by Schenck and that described by Beurmann.

Clinical Forms.—Beurmann and Gougerot recognize three groups: First, the disseminated gummatous form in which in the subcutaneous tissues in various parts of the body there are small, firm, solid nodules, which break down and form small abscesses, ulcerating the skin. In the second, ulcerative, type the lesions are not unlike those of cutaneous tuberculosis, occurring commonly on the hands and arms, though they may appear on the legs or on the body. They may be single or in groups of two or three, and in several of the cases I had an opportunity of seeing in Paris they resembled very much eroded syphilitic gummata. In the third form there is a localized lesion, a hard chancroid body, eroded on the surface. Dissemination occurs through the lymphatics, the regional glands become involved and there may

wrs/

be a group of open sores along the arm or on the side of the head. Fourthly, there are certain extra-cutaneous forms—ulcerous lesions of the mucous membranes, gummata of the muscles and an ulcerative osteo-myelitis. The disease rarely generalizes in the internal organs but the parasite has been found in connection with a pyelonephrosis.

The disease is essentially chronic, lasting often for a year or two; sometimes disturbing the health very slightly, and other times leading to anæmia. There may be no fever, but instances of acute attacks have been reported.

Diagnosis.—This has to be made from tuberculosis, syphilis, and actinomycosis, which may be done by cultures (as the parasites grow in a very specific way) and by ~~the methods of~~ sporo-agglutination and the fixation reaction, the full details of which are given in Beurmann's and Gougerot's manual.

Treatment.—As a rule this is surgical, but the iodide of potassium has a most beneficial effect.

III. NOCARDIOSIS

J. H. Wright of Boston ~~has~~ separated this group from the actinomycoses and the streptothrix infections. On the one hand the parasites resemble bacteria, on the other hand the hypomycetes or moulds, in forming branching, thread-like filaments and in the production of fine conidia. They represent a transition between the bacteria and the lower fungi.

Wright states that there are not more than a dozen well reported human cases, the majority of which have had the signs and symptoms of pulmonary tuberculosis or of multiple abscesses. In the lungs nodules, caseous masses and lesions not unlike tubercle have been found. In three cases there was abscess of the brain.

The parasite may be recognized by the typically branched filaments and by the growth in cultures.

IV. OÏDIOMYCOSIS

Under this term is ~~now~~ described a form of infective dermatitis, of which some 50 or 60 cases have been reported, all, with few exceptions, in the United States. It has been called blastomycosis and saccharomycosis, and, as the parasites were at first thought to be protozoon, coccidioidal or protozoic dermatitis. The parasite grows as a spherical or oval budding cell which is capable of producing a mycelium with aerial hyphæ.

The essential lesion is a granuloma, resembling tuberculosis and involving the skin of the face as a rule, but sometimes the lesions are multiple and there is extensive ulceration from the breaking down of the nodules. In a few cases the lungs and other parts have been affected. A secondary meningitis has been described, and grayish nodular infiltrations have been found in the liver, spleen, lymph glands and other organs. The disease is chronic, lasting for many years.

The *diagnosis* is easily made by the microscopic examination of material from the small abscesses, or a fragment of the tissue.

When localized, recovery may take place, but when the lungs or internal

organs are involved, or if the skin lesions are very extensive, death follows. For *treatment,* the actual cautery, excision, the X-rays and the internal administration of iodide of potassium may be tried.

V. MYCETOMA

(*Madura Disease*)

Vandyke Carter of Bombay, a pioneer in the study of tropical diseases, gave an admirable description of this affection, which prevails largely in certain districts of India, and ~~sporadically~~ in other parts of the world.

The disease, usually involving the foot, is characterized by great swelling, nodular growths and the formation of multiple abscesses. There are remarkable granules 1 mm. in diameter, usually of a black color, which occur in the discharges; in other cases the granules are yellow or brownish in color. In the pale variety a streptothrix has been found, which morphologically closely resembles actinomyces. It is held by most observers that this streptothrix maduræ and actinomyces are distinct species. From the black variety of granules a hypomycete has been grown, an organism closely allied to aspergillus.

The disease begins as a granuloma, with swelling of the foot, generally on the sole. The tumors gradually soften, others form, the foot increases enormously in bulk, becomes much deformed, numerous sinuses pass between the bones, the discharges are muco-purulent and contain the characteristic granules. The only satisfactory *treatment* is early excision or, in later stages, amputation of the foot.

VI. ASPERGILLOSIS

Bennett in 1842 described the parasite from the lungs, the *Aspergillus fumigatus,* a fungus widely distributed as a harmless parasite, having been found in the auditory canal, nose and throat. In birds, in cattle, more rarely in dogs, the aspergillus may cause lesions of the lungs resembling tuberculosis, and there have of late years been a good many cases reported in man, particularly in pigeon keepers and hair sorters. In the majority of cases the infection is secondary to some long-standing affection of the lungs, but it has been met with as a primary disease with lesions resembling broncho-pneumonia, which undergo necrosis and softening and the clinical picture is that of ordinary tuberculosis.

The symptoms are those of chronic pulmonary disease, cough, fever, and expectoration, in which the aspergillus is found. It is readily recognized by the character of its spores. In the case which I reported, at intervals of two or three months for twelve years the patient coughed up, usually with a good deal of difficulty, a grayish-brown mass the size of a small bean, which was made up entirely of the mycelium and spores of the aspergillus. The interesting point was that the patient had no symptoms, other than the cough, and was in excellent health.

In the majority of cases the outlook is bad, and the treatment is that of chronic tuberculosis.

coccoid parasite found. Under

Julianus nicotiae Quantin mg cum. (Dews + Newman
Wellcome)

Dysenterie -

protozoa - E. histolytica - leishmania, Balantidium coli

helminthes - Schistosoma japonicum + S. mansoni

bacteria - [illegible]

name

C. PROTOZOAN INFECTIONS

I. PSOROSPERMIASIS

Though widely spread in invertebrates, pathogenic psorosperms are not common in mammals, and in man serious disease is very rarely caused by them.

One of the commonest and most readily studied forms of psorosperm is the so-called Rainey's tube, an ovoid body found in the muscle of the pig, within the sarcolemma, filled with small sickle-shaped unicellular organisms, *Sarcocystis miescheri*. In a few instances similar structures have been found in the muscles of man. The only human parasite of this group which has caused serious disease belongs to the *coccidia*.

Coccidiosis.—In a majority of the cases of this group the psorosperms have been found in the liver, producing a disease similar to that which occurs in rabbits. In Guebler's case there were tumors which could be felt during life, and they were determined by Leuckart to be due to coccidia. A patient of W. B. Haddon's was admitted to St. Thomas's Hospital with slight fever and drowsiness, and gradually became unconscious—death occurring on the fourteenth day of observation. Whitish neoplasms were found upon the peritoneum, omentum, and on the layers of the pericardium; and a few were found in the liver, spleen, and kidneys. A somewhat similar case, though more remarkable, as it ran a very acute course, is reported by Silcott. A woman, aged fifty-three, admitted to St. Mary's Hospital, was thought to be suffering from typhoid fever. She had had a chill six weeks before admission. There were fever of an intermittent type, slight diarrhœa, nausea, tenderness over the liver and spleen, and a dry tongue; death occurred from heart-failure. The liver was enlarged, weighed 83 ounces, and in its substance there were caseous foci, around each of which was a ring of congestion. The spleen weighed 16 ounces and contained similar bodies. The ileum presented six papule-like elevations. The masses resembled tubercles, but on examination coccidia were found.

The parasites are also found in the kidneys and ureters. Cases of this kind have been recorded by Bland Sutton and Paul Eve. In Eve's case the symptoms were hæmaturia and frequent micturition, and death took place on the seventeenth day. The nodules throughout the pelvis and ureters have been regarded as mucous cysts.

II. AMŒBIASIS

Entamœba histolytica

(*Amœbic Dysentery, Amœbic Hepatitis*)

Definition.—A colitis, acute or chronic, caused by the *Amœba dysenteriæ* with a special liability to the formation of abscesses of the liver.

Distribution.—The disease is widely prevalent in Egypt, in India and in tropical countries. In Europe sporadic cases occur, rarely small epidemics. It is ~~an~~ uncommon ~~disease~~ in Great Britain. It is a common variety throughout the United States, particularly in the Southern States, where it is

endemic, increasing sometimes to such an extent as to form an epidemic. Sporadic cases occur in all temperate regions. The relative frequency of this form of dysentery in the tropics is illustrated by the Manila statistics as given by Strong; of 1,328 cases in the United States Army, 561 were of the amœbic variety. The cases of acute and chronic dysentery in the Johns Hopkins Hospital have been almost exclusively amœbic. To 1908 of 182 cases, 123 came from the State of Maryland.

Age.—It is not uncommon in children but the greatest number of cases occur between the ages of 20 and 35.

Sex.—Males are much more frequently affected. Of 182 cases at the Johns Hopkins Hospital 171 were males (Futcher).

Race.—The white race is more susceptible, 163 whites to 19 blacks in the Johns Hopkins Hospital series. In the Philippines the whites are more often attacked. In India the disease is common in the native races.

The Amœba.—The organism *Amœba dysenteriæ* was first described by Lanbl in 1859 and subsequently by Lösch in 1875. Kartulis in 1886 found them in the stools of the endemic dysentery in Egypt and in the liver abscesses. In 1890 I found them in a case of dysentery with abscess of the liver originating in Panama. Subsequently from my wards a series of cases was described by Councilman and Lafleur. The studies of Quincke and Roos, of Dock, Harris and others in the United States, of Strong and Musgrave in the Philippines, of Kruse and Pasquale in Egypt and of Leonard Rogers in India have put our knowledge of the disease on a firm basis. To find the amœbæ the little flakes of mucus or pus in the stools should be selected for examination or the mucus obtained by passing a soft rubber ~~catheter~~. Musgrave holds that the best way is to give the patient a saline cathartic and then examine the fluid portion of the stool.

Amœba or *Entamœba dysenteriæ* is from 15 to 20 μ in diameter, has a clear outer zone (ectosarc) and a granular inner zone (endosarc), and contains a nucleus and one or two vacuoles. The movements are similar to those of the ordinary pond amœba, consisting of slight protrusions of the protoplasm. They vary a good deal, and usually may be intensified by having the slide heated. Not infrequently the amœbæ contain red blood corpuscles. In the tissues they are very readily recognized by suitable stains. They may be in enormous numbers, and sometimes the field of the microscope is completely occupied. In the pus of a liver abscess they may be very abundant, though in large, long standing abscesses they may not be found until after a few days, when the pus begins to discharge from the wall. In the sputum in the cases of pulmono-hepatic abscess they are readily recognized.

Amœbæ are frequently found in the stools of healthy persons, as Cunningham and Lewis pointed out. Schaudinn found them in from 20 to 60 per cent. in Germany, but they vary greatly in different localities. Among 300 persons in Manila, Musgrave found 101 infected with amœbæ, 61 of these had dysentery, the remaining 40 had no diarrhœa. In the next two months 8 of the 40 cases died and showed amœbic infection of the bowel. Within the next three months the remaining 32 had dysentery. Musgrave believes that at any time the amœba may become pathogenic. Schaudinn described two distinct forms—a non-pathogenic *Entamœba coli,* and a pathogenic larger form, the *Entamœba histolytica,* the same as the *Amœba dysenteriæ,*

Schaudinn.

Endamoeba histolytica
halt. v. E. coli as nuc.
halter
? as halt of E. coli

Lösch cultures in coli ?!
C. Thaxter. cultures can. dysenteriae

tube]

Carrières - en m' haut.

with a strongly refractile hyaline ectoplasm. The amœbæ can be cultivated, but with difficulty, and it is doubtful if they grow apart from certain bacteria. Resistant forms, somewhat analogous to the gamete forms of the malarial parasite, have been described. These "encysted amœbæ" are believed to be necessary, under certain conditions, for the transmission of the disease from one person to another, and are regarded by Musgrave and Clegg as the most dangerous forms of the organism. Cultures of amœbæ have been shown to withstand drying for from eleven to fifteen months.

Morbid Anatomy.—Intestines.—The lesions consist of ulceration, produced by preceding infiltration, general or local, of the submucosa, due to an œdematous condition and to multiplication of the fixed cells of the tissue. In the earliest stage these local infiltrations appear as hemispherical elevations above the general level of the mucosa. The mucous membrane over these becomes necrotic and is cast off, exposing the infiltrated submucous tissue as a grayish yellow gelatinous mass, which at first forms the floor of the ulcer, but is subsequently cast off as a slough. The individual ulcers are round, oval, or irregular, with infiltrated, undermined edges. The visible aperture is often small compared to the loss of tissue beneath it, the ulcers undermining the mucosa, coalescing, and forming sinuous tracts bridged over by apparently normal mucous membrane. According to the stage at which the lesions are observed, the floor of the ulcer may be formed by the submucous, the muscular, or the serous coat of the intestine. The ulceration may affect the whole or some portion only of the large intestine, particularly the cæcum, the hepatic and sigmoid flexures, and the rectum. In severe cases the whole of the intestine is much thickened and riddled with ulcers, with only here and there islands of intact mucous membrane. In 100 autopsies on this disease in Manila the appendix was involved in 7; perforation of the colon took place in 19.

The disease advances by progressive infiltration of the connective tissue layers of the intestine, which produces necrosis of the overlying structures. Thus, in severe cases there may be in different parts of the bowel sloughing *en masse* of the mucosa or of the muscularis, and the same process is observed, but not so conspicuously, in the less severe forms. In some cases a secondary diphtheritic inflammation complicates the original lesions. Healing takes place by the gradual formation of fibrous tissue in the floor and at the edges of the ulcers, which may ultimately result in partial and irregular strictures of the bowel.

Microscopic examination shows a notable absence of the products of purulent inflammation. In the infiltrated tissues polynuclear leucocytes are seldom found, and never constitute purulent collections. On the other hand, there is proliferation of the fixed connective tissue cells. Amœbæ are found more or less abundantly in the tissues at the base of and around the ulcers, in the lymphatic spaces, and occasionally in the blood vessels. The portal capillaries occasionally contain them, and this fact seems to afford the best explanation for the mode of infection of the liver.

Liver.—The lesions are of two kinds: first, local necroses of the parenchyma, scattered throughout the organ, and possibly due to the action of chemical products of the amœbæ; and, secondly, abscesses. These may be single or multiple. There were 37 cases of hepatic abscess among the 182

cases of amœbic dysentery in my wards. Of these, 18 came to autopsy. In 10 the abscess was single and in 8 multiple. When single they are generally in the right lobe, either toward the convex surface near its diaphragmatic attachment or on the concave surface in proximity to the bowel. Multiple abscesses are small and generally superficial. There may be innumerable miliary abscesses containing amœbæ scattered throughout the organ. Although the hepatic abscess usually occurs within the first two months from the onset of the dysentery, in one of my cases the latter had lasted one and in another six years. In 5 cases the intestinal symptoms had been so slight that dysentery had never been complained of. In 2 fatal cases there were only scars of old ulcers and in 2 others the mucosa appeared normal. In an early stage the abscesses are grayish yellow, with sharply defined contours, and contain a spongy necrotic material, with more or less fluid in its interstices. The larger abscesses have ragged necrotic walls, and contain a more or less viscid, greenish yellow or reddish yellow purulent material mixed with blood and shreds of liver tissue. The older abscesses have fibrous walls of a dense, almost cartilaginous toughness. A section of the abscess wall shows an inner necrotic zone, a middle zone in which there are great proliferation of the connective-tissue cells and compression and atrophy of the liver-cells, and an outer zone of intense hyperæmia. There is the same absence of purulent inflammation as in the intestine, except in those cases in which a secondary infection with pyogenic organisms has taken place.

Lesions in the lungs are seen when an abscess of the liver—as so frequently happens—points toward the diaphragm and extends by continuity through it into the lower lobe of the right lung. This is the commonest situation for rupture to occur. Nine of my cases ruptured into the lung. In 3 cases rupture into the right pleura occurred, causing an empyema. In one of these the lung abscess ruptured into the pleura, producing a pyo-pneumothorax. Perforation may occur into *adjacent structures*. In 3 of the cases perforation took place into the inferior vena cava and in another the upper pole of the right kidney had been invaded. The abscess may rupture into the pericardium, peritoneum, stomach, intestine, portal and hepatic veins, or externally.

Symptoms.—Differing remarkably, ~~in their symptoms,~~ three groups of cases may be recognized:

Mild Form.—Infection may be present for a month or two before the individual is aware of it. There may be vague symptoms—headache, lassitude, weakness, slight abdominal pains and occasional diarrhœa, features common enough in the tropics. Strong gives the case of a laboratory chemist who had slight diarrhœa for one day and asked to have the stools examined; an unusually rich infection with amœba was found. The next day he felt well. From August to December amœbæ were present in the stools, though he had no symptoms. Liver abscess may occur in these cases.

Acute Amœbic Dysentery.—Many cases have an acute onset. Pain and tenesmus are common. The stools are bloody, or mucus and blood occur together. In very severe cases there may be constant tenesmus, with pain of the greatest intensity, and the passage every few minutes of a little blood and mucus. In some cases large sloughs are passed. The temperature as a rule is not high. The patient may become rapidly emaciated; the heart's action

apt to have periodicity in attacks of syncope.

Ingen?

Syst
Stenosis

becomes feeble, and death may occur within a week of the onset. Among other symptoms are hæmorrhage from the bowels, which occurred in three cases, and perforation of an ulcer with general peritonitis, which occurred in three cases. A majority of the patients recover; in others the disease drags on and becomes chronic. In a few cases, after the separation of the sloughs, there is extensive ulceration remaining, with thickening and induration of the colon, and the patient has constant diarrhœa, loses weight, and ultimately dies exhausted, usually within three months of the onset. With the exception of cancer of the œsophagus and anorexia nervosa, no such extreme ~~grade of~~ emaciation is seen. Extensive ulceration of the cornea may occur.

Chronic Amœbic Dysentery.—The disease may be subacute from the onset, and gradually passes into a chronic stage, the special characteristic of which is alternating periods of constipation and of diarrhœa. These may occur over a period of from six months to a year or more. Some of our patients have been admitted to the hospital five or six times within a period of two years. During the exacerbations there are pain, frequent passages of mucus and blood, and a slight rise of temperature. Many patients do not feel very ill, and retain their nutrition in a remarkable way; indeed, in the United States it is rare to see the extreme emaciation so common in the chronic cases from the tropics. Alternating periods of improvement with attacks of diarrhœa are the rule. The appetite is capricious, the digestion disordered, and slight errors in diet are apt to be followed at once by an increase in the number of stools. The tongue is often red, glazed, and beefy.

Complications and Sequelæ.—Liver Abscess.—A pre-suppurative stage lasting for several weeks or months is recognized by Rogers, characterized by fever of an intermittent type, moderate leucocytosis, and an enlarged and tender liver. Suppuration in the liver is the most serious and frequent complication. Abscess of the brain has occurred.

Perforation of the intestine and peritonitis occurred in three of my cases. Intestinal hæmorrhage occurred three times. The infrequency of this complication is probably due to the thrombosis of the vessels about the areas of infiltration. Occasionally an arthritis, probably toxic in origin, may occur. There was one case in my series. Five cases were complicated by malaria; 1 by typhoid fever; 1 by pulmonary tuberculosis; and 1 by a strongyloides intestinalis infection.

Diagnosis.—From the other forms of dysentery the disease is recognized by the finding of amœbæ in the stools. Unless one sees undoubted amœboid movement a suspected body should not be considered an amœba. A non-motile body containing one or more red cells is most probably an amœba, but should only lead to further search for motile organisms. Swollen epithelial cells are confusing, but the hyaline periphery is not amœboid in its action as is the ectosarc of the amœba. The trichomonads and cercomonads so frequently associated with amœbæ are not likely to give trouble. The extent of liver dulness should be watched throughout the course ~~of a case~~, and any increase upward or downward should lead to the suspicion of a liver abscess. Hepatic abscess is usually accompanied by fever, sweats, or chills and local pain, but ~~it~~ may be entirely latent. Exploratory puncture is safe as a rule and, personally, I have never seen any ill effects, but severe hæmorrhage

into the peritoneum, six cases of which were recorded by Hatch in India, may occur. A varying leucocytosis occurs in the abscess cases. The highest count in my series was 53,000, the average being 18,350. The average leucocyte count in the uncomplicated dysentery cases was 10,600. Hepato-pulmonary abscess is attended by local lung signs and the expectoration of "anchovy sauce" sputum in which amœbæ are almost invariably found.

Prognosis.—In many cases the disease yields to rest and intestinal medication. Tendency to a relapse of the dysenteric symptoms is one of the striking characteristics of the disease. One of my patients was admitted to the hospital five times in nine months.

Treatment.—Rest in bed is very important, even in mild attacks, and materially hastens recovery. The diet should be governed by the severity of the intestinal manifestations. In the very acute cases the patient should be given a liquid diet, consisting of milk, whey, and broths.

A return to the use of ipecacuanha is the most important event of late years in the treatment of this form of dysentery. The experience of Rogers in India and of the American physicians in the Philippines and Panama shows it to be almost a specific. It should always be tried, even in chronic cases. It must be given in salol-coated pills or keratin capsules so that it is not dissolved in the stomach. The patient should be on milk diet and without anything by mouth for three hours before the drug is given, the best time for administration being at bedtime. One dose is given each night; the first may be 60 to 90 grains (4 to 6 gm.), which is reduced by five grains each night until it is down to ten grains (0.6 gm.). This course should be repeated in a week if amœbæ remain in the stools. Rogers advises the same drug to prevent liver abscess when there is a suspicion of hepatitis. Doses of 20 to 30 grains (1.3 to 2 gm.) are given daily and continued for two weeks after the temperature is normal.

Bismuth probably does more harm than good, owing to the fact that it coats the surface of the ulcers so that the solutions used in the injections can not reach the amœbæ in the ulcer walls. It is well in the chronic forms to give an occasional dose of saline or castor oil. Large injections of quinine solution in the strength of 1 to 5,000, gradually increasing to 1 to 500, have given the most satisfactory results of all the local remedies. The amœbæ are rapidly destroyed by the drug. The success of the treatment depends largely on the care with which the injections are given. The failures are undoubtedly, in many instances, due to the fact that sufficient care is not used to insure the solution reaching the cæcum and ascending colon, where the ulceration is often most severe. From a litre to two litres should be allowed to flow into the colon. The patient's hips should be elevated and he should change his position so as to allow the fluid to flow into all parts of the colon. The solution should be retained, if possible, for fifteen minutes. One or two injections may be given daily. Injections of silver nitrate solution (1 to 2,000, increased to 1 to 500) are useful in chronic cases, given in the same way. Tuttle has recently reported good results in the treatment of amœbic dysentery by the use of simple ice-water enemas, given frequently. When there is much tenesmus a small injection of thin starch and half a drachm to a drachm of laudanum gives great relief. Local application to the abdomen, in the form of light poultices, or turpentine stupes, are very grateful.

Emetine hydrochloride. - gr 1/3 t.i.d. for 7-10 days only.
Tendency to give rise on the 5th day.

Emetine dihydrochloride - in ipecac to recover 3.

Carrico - Treatment. Walker & Emmich. J.A.M.A. May 19, 17.
Emetin - not very successful. Radium
Oil of chenopodium - Pure preparation. Ipecac is important.
1. Mag. sulph. 1/2 - 1 ounce at 6 a.m.
2. Oil of chenopodium - in gelatin capsules - 16 minims - at 8 & 10 a.m. & 12 noon. Fri. only.
3. Castor oil 3ij with chloroform 50 minims at 2 P.M.

Some cases of [illegible]

Dale, Law & Dobell have used emetine bismuth iodide.
Bismuth. Intramuscular emetine given by
(Dublin M.J. (Quart. J. July 7, 17) in broken emetine mercuric iodide
& bismuth
Emetine bismuth iodide in capsules.
gr 32 - 36 in full course - daily dose gr 2 - 3.

Somal

When medical treatment fails, colostomy may be tried or irrigations given through the appendix.

Hepatic abscess should be drained at once and the cavity irrigated by quinine solution (1 to 1,000). Ipecacuanha should be given persistently, as advised for the dysentery.

III. MALARIAL FEVER

Definition.—An infectious disease with: (*a*) paroxysms of intermittent fever of quotidian, tertian, or quartan type; (*b*) a continued fever with marked remissions; (*c*) certain pernicious, rapidly fatal forms; and (*d*) a chronic cachexia, with anæmia and enlarged spleen.

The hæmocytozoa described by Laveran, which are transmitted to man by the bite of the mosquito, are invariably associated with the disease. Malaria occurs as an endemic and epidemic disease, the latter prevailing in the tropics under favoring conditions. No infection except, perhaps, tuberculosis compares with it in the extent of its distribution or its importance as a killing and disabling disease.

Geographical Distribution.—In Europe, southern Russia and certain parts of Italy are now the chief seats of the disease. It is rare in Germany, France, and England, and the foci of epidemics are becoming yearly more restricted. In the United States malaria has progressively diminished in extent and severity during the past fifty years. From New England, where it once prevailed extensively, it has gradually disappeared, but there has of late years been a slight return in some places. In the city of New York even the milder forms of the disease are very rare. In Philadelphia and along the valleys of the Delaware and Schuylkill Rivers, formerly hot-beds of malaria, the disease has become much restricted. In Baltimore a few cases occur in the autumn, but a majority of the patients seeking relief are from the outlying districts and ~~one or two~~ of the inlets of Chesapeake Bay. Throughout the Southern States there are many regions in which malaria prevails; but here, too, the disease has diminished in prevalence and intensity. In temperate regions, like the central Atlantic States, there are only a few cases in the spring, usually in the month of May, and a large number of cases in September and October, and sometimes in November. In the Northwestern States malaria is almost unknown. It is rare on the Pacific coast. In the region of the Great Lakes malaria prevails only in the Lake Erie and Lake St. Clair regions. The St. Lawrence basin remains free from the disease.

In India the disease is very prevalent, particularly in the great river basins. Terrible epidemics occur. In the Punjab in 1908 there were more than three million deaths from fever, a large proportion of which were from malaria. In the months of October and November there were 307,317 deaths from the disease. In Burma and Assam severe types are met with. In Africa the malarial fevers form the great obstacle to European settlements on the coast and along the river basins. The *black-water* or West African fever of the Gold Coast is a very fatal type of malarial hæmoglobinuria. The Atlantic coast line of Central America is severely infected, and the Isthmus of Panama for centuries was known as the "white man's grave."

In the tropics there are minimal and maximal periods, the former cor-

responding to the summer and winter, the latter to the spring and autumn months.

Etiology: The Parasite.—History.—Parasites of the red blood corpuscles—hæmocytozoa—are very widespread throughout the animal series. They are met with in the blood of frogs, fish, birds, and among mammals in monkeys, bats, cattle, and man. In birds and in frogs the parasites appear to do no harm except when present in very large numbers.

In 1880 Laveran, a French army surgeon stationed at Algiers, noted in the blood of patients with malarial fever pigmented bodies, which he regarded as parasites, and as the cause of the disease. Richard, another French army surgeon, confirmed these observations. In 1885 Marchiafava and Celli described the parasites with great accuracy, and in the same year Golgi made the all-important observation that the paroxysm of fever invariably coincided with the sporulation or segmentation of a group of the parasites. In the following year (1886) Laveran's observations were brought before the profession of the United States by Sternberg. Councilman and Abbott had already, in the previous year, described the remarkable pigmented bodies in the red blood corpuscles in the blood vessels of the brain in a fatal case, and in 1886 Councilman confirmed the observations of Laveran in clinical cases. Stimulated by his work, I began studying the malarial cases in the Philadelphia Hospital, and soon became convinced of the truth of Laveran's discovery, and was able to confirm Golgi's statement as to the coincidence of the sporulation with the paroxysm. The work was taken up actively in the United States by Walter James, Dock, Koplik, Thayer, Hewetson, and others, and in a number of subsequent communications I tried to emphasize the extraordinary clinical importance of Laveran's discovery.*

Among British observers, Vandyke Carter alone, in India, seems to have appreciated at an early date the profound significance of Laveran's work.

The next important observation was the discovery by Golgi that the parasite of quartan malarial fever differed from the tertian. From this time on the Italian observers took up the work with great energy, and in 1889 Marchiafava and Celli determined that the organism of the severer forms of malarial fever differed from the parasite of the tertian and quartan varieties.

The idea that fever was transmitted by the bite of the mosquito prevailed widely in the West Indies and in the Southern States. King, of Washington, warmly advocated this view. The important rôle played by insects as an intermediate host had been shown in the case of the Texas cattle fever, in which Theobald Smith demonstrated that the hæmatozoa developed in, and the disease was transmitted by, ticks; but it remained for Manson to for-

* The following references to work on malaria which has been done in connection with my clinic, chiefly under the supervision of my colleague, Professor Thayer, may be of interest: Philadelphia Medical Times, 1886; British Medical Journal, March, 1887; Medical News, 1889, vol. i; Johns Hopkins Hospital Bulletin, 1889; the first edition of my Text-Book of Medicine, 1892; Thayer and Hewetson, Johns Hopkins Hospital Reports, 1895; Thayer, Lectures on Malarial Fever, 1897; W. G. MacCallum, Hæmatozoa of Birds, Jour. of Exp. Med., 1898; Opie, on the Hæmatozoa of Birds, 1898; Barker, on Fatal Cases of Malaria, Johns Hopkins Hospital Reports, 1899; MacCallum, on the Significance of the Flagella, Lancet, 1897; Thayer, Transactions American Medical Congress, vol. iv, 1900; Lazear, Structure of the Malarial Parasites, Johns Hopkins Hospital Reports, 1902.

mulate in a clear and scientific way the theory of infection in malaria by the mosquito. Impressed with the truth of this, Ross studied the problem in India, and showed that the parasites developed in the bodies of the mosquitoes, demonstrating conclusively that the infection in birds was transmitted by the mosquito. W. G. MacCallum suggested that the flagella were sexual elements, and observed the process of fertilization by them. Studies by Grassi, Bastianelli and Bignami, and many others, confirmed the observations of Ross and demonstrated the fact that the malarial parasites of human beings develop only in mosquitoes of the genus anopheles.

Then came the practical demonstration by Italian observers, and by the interesting experiments on Manson, Jr., of the direct transmission of the disease to man by the bite of infected mosquitoes. And lastly, as a practical conclusion of the whole matter, the anti-malarial campaigns so energetically advocated and carried out by Ross have shown that by protecting the individual from the bites of mosquitoes, by exterminating the insects, or by carefully treating all patients so that no opportunity may be offered for the parasite to enter the mosquito, malaria may be eradicated from any locality.

General Morphology of the Parasite.—Belonging to the sporozoa, it has received a large number of names. The term *Plasmodium*, inapt though it may be, must, according to the rules of zoological nomenclature, be applied to the human parasite. There are three well-marked varieties which exist in two separate phases or stages: (*a*) the parasite in man, who acts as the intermediate host, and in whom, in the cycle of its development, it causes symptoms of malaria; and (*b*) an extracorporeal cycle, in which it lives and develops in the body of the mosquito, which is its definitive host.

(*a*) *The Parasite in Man.*—(1) The Parasite of Tertian Fever (*Plasmodium vivax*).—The earliest form seen in the red blood corpuscle is round or irregular in shape, about 2 μ in diameter and unpigmented. It corresponds very much in appearance with the segments of the rosettes formed during the chill. A few hours later the body has increased in size, is still ring-shaped, and there is pigment in the form of fine grains. It has a relatively large nuclear body, consisting of a well-defined, clear area, in part almost transparent, in part consisting of a milk-white substance, in which there lies a small, deeply staining chromatin mass. At this period it usually shows active amœboid movements, with tongue-like protrusions. The pigment increases in amount and the corpuscle becomes larger and paler, owing to a progressive diminution of its hæmoglobin. There is a gradual growth of the parasite, which, toward the end of forty-eight hours, occupies almost all of the swollen red corpuscle. It is now much pigmented, and is in the stage of what is often called the full-grown parasite. Between the fortieth and forty-eighth hours many of the parasites are seen to have undergone the change known as segmentation, in which the pigment becomes collected into a single mass or block, and the protoplasm divides into a series of from fifteen to twenty spores, often showing a radial arrangement. Certain full-grown tertian parasites, however, do not undergo segmentation. These forms, which are larger than the sporulating bodies, and contain very actively dancing pigment granules, represent the sexually differentiated form of the parasite—gametocytes.

(2) The Parasite of Quartan Fever (*Plasmodium malariæ*).—The earliest form is very like the tertian in appearance, but as it increases in size the

earlier granules are coarser and darker and the movement is not nearly so marked. By the second day the parasite is still larger, rounded in shape, scarcely at all amœboid, and the pigment is more often arranged at the periphery of the parasite. The rim of protoplasm about it is often of a deep yellowish-green color or of a dark brassy tint. On the third day the segmenting bodies become abundant, the pigment flowing in toward the centre of the parasite in radial lines so as to give a star-shaped appearance. The parasites finally break up into from six to twelve segments. Here also, as in the case of the tertian parasite, some full-grown bodies persist without sporulating, representing the gametocytes.

(3) The Parasite of the Æstivo-Autumnal Fever (*Plasmodium falciparum*).—This parasite is considerably smaller than the other varieties; at full development it is often less than one-half the size of a red blood corpuscle. The pigment is much scantier, often consisting of a few minute granules. At first only the earlier stages of development, small, hyaline bodies, sometimes with one or two pigment granules, are to be found in the peripheral circulation; the later stages are ordinarily to be seen only in the blood of certain internal organs, the spleen and bone marrow particularly. The corpuscles containing the parasites become not infrequently shrunken, crenated, and brassy-colored. After the process has existed for about a week, larger, refractive, crescentic, ovoid, and round bodies, with central clumps of coarse pigment granules, begin to appear. These bodies are characteristic of æstivo-autumnal fever. The crescentic and ovoid forms are incapable of sporulation; they are analogous to the large, full-grown, non-sporulating bodies of the tertian and quartan parasites which have been mentioned above, and represent sexually differentiated forms—gametocytes. Within the human host they are incapable of further development, but upon the slide, or within the stomach of the normal intermediate host, the mosquito, the male elements (micro-gametocytes) give rise to a number of long, actively motile flagella (micro-gametes) which break loose, penetrating and fecundating the female forms—macro-gametes (W. G. MacCallum). The fecundated female form enters into the stomach wall of the intermediate host, the mosquito, where it undergoes a definite cycle of existence.

(*b*) *The Parasite within the Body of the Mosquito.*—The brilliant researches of Ross, followed by the work of Grassi, Bastianelli, Bignami, Stephens, Christophers, and Daniels, have proved that a certain genus of mosquito—anopheles—is not only the intermediate host of the malarial parasite, but also the sole source of infection. In the present state of our knowledge it would appear that all species of the genus anopheles may act as hosts of the parasite. The more common genera of mosquito in temperate climates are culex and anopheles. The different species of culex form the great majority of our ordinary house mosquitoes, and are apparently incapable of acting as hosts of the malarial parasite. All malarial regions, however, which have been investigated contain anopheles. Although this is apparently a positive rule, anopheles may, however, be present without the existence of malaria under two circumstances: first, when the climate is too cold for the development of the malarial parasite; and secondly, in a region which has not yet been infected. So far as is known, the parasite exists only in the mosquito and in man. It is apparently fair to state that regions in which

mosquitoes of the genus anopheles are present may become malarious during the warm season.

A large number of species of anopheles have been described. In North America, however, only four have been positively recognized: *A. punctipennis* (Say), *A. maculipennis* (Wied.), *A. crucians* (Wied.), *A. argyritarsis* (Desv.). The commonest variety, and that which in all probability is most concerned in the spread of the disease, is *A. maculipennis*, which is, also, the most important agent in the spread of the disease in Europe. In parts of India, *e. g.* Bombay, the common anopheles, *Neocellia rossi*, plays no part, but the carrier is *N. stephensi*.

The culex lays its eggs in sinks, tanks, cisterns, and any collection of water about or in houses, while the anopheles lays its eggs in small, shallow puddles or slowly running streams, especially those in which certain forms of algæ exist. The culex is essentially a city mosquito, the anopheles a country insect.

Evolution in the Body of the Mosquito.—When a mosquito of the genus anopheles bites an individual whose blood contains sex-ripe forms (gametocytes) of the malarial parasite, flagellation and fecundation of the female element occur within the stomach of the insect. The fecundated element then penetrates the wall of the mosquito's stomach and begins a definite cycle of development in the muscular coat. Two days after biting there begin to appear small, round, refractive, granular bodies in the stomach wall of the mosquito, which contain pigment granules clearly identical with those previously contained in the malarial parasite. These develop until at the end of seven days they have reached a diameter of from 60 to 70 μ. At this period they may be observed to show a delicate radial striation due to the presence of great numbers of small sporoblasts. The mother oöcyst (zygote) then bursts, setting free into the body cavity of the mosquito an enormous number of delicate spindle-shaped sporozoids. These accumulate in the cells of the veneno-salivary glands of the mosquito, and, escaping into the ducts, are inoculated with subsequent bites of the insect. These little spindle-shaped sporozoids develop, after inoculation into the warm-blooded host, into fresh young parasites. The sporozoid which has developed in the oöcyst in the stomach wall of the mosquito is then the equivalent of the spore resulting from the asexual segmentation of the full-grown parasite in the circulation. Either one, on entering a red blood corpuscle, may give rise to the asexual or sexual cycle. As a rule the first several generations of parasites in the human body pursue the asexual cycle, the sexual forms developing later. These sexual forms, sterile while in the human host, serve as the means of preserving the life of the parasite and spreading infection when the individual is subjected to bites of anopheles.

Morbid Anatomy.—The changes result from the disintegration of the red blood corpuscles, accumulation of the pigment thereby formed, and possibly the influence of toxic materials produced by the parasite. Cases of simple malarial infection, ague, are rarely fatal, and our knowledge of the morbid anatomy of the disease is drawn from the pernicious malaria or the chronic cachexia. Rupture of the enlarged spleen may occur spontaneously, but more commonly from trauma. I have known fatal hæmorrhage to follow the exploratory puncture of an enlarged malarial spleen.

Pernicious Malaria.—The blood is hydræmic and the serum may even be tinged with hæmoglobin. The red blood corpuscles present the endoglobular forms of the parasite and are in all stages of destruction. The *spleen* is enlarged, often only moderately; thus, of two fatal cases in my wards the spleens measured 13×8 cm. and 14×8 cm. respectively. In a fresh infection the spleen is usually very soft, and the pulp lake-colored and turbid. The *liver* is swollen and turbid.

In some acute pernicious cases with choleraic symptoms the capillaries of the gastro-intestinal mucosa may be packed with parasites.

Malarial Cachexia.—In fatal cases of chronic paludism death occurs usually from anæmia or the hæmorrhage associated with it. The anæmia is profound, particularly if the patient has died of fever.

The spleen may weigh from five to ten pounds. The liver may be greatly enlarged, and presents to the naked eye a grayish-brown or slate color, due to the large amount of pigment. In the portal canals and beneath the capsule the connective tissue is impregnated with melanin. The pigment is seen in the Kupffer's cells and the perivascular tissue. The kidneys may be enlarged and present a grayish-red color, or areas of pigmentation may be seen. The peritoneum is usually of a deep slate color. The mucous membrane of the stomach and intestines may have the same hue, due to the pigment in and about the blood-vessels. In some cases this is confined to the lymph nodules of Peyer's patches, causing the shaven-beard appearance.

The Accidental and Late Lesions of Malarial Fever.—(*a*) *The Liver.*—Paludal hepatitis plays a very important rôle in the history of malaria, as described by French writers. Only those cases in which the history of chronic malaria is definite, and in which the melanosis of both liver and spleen coexist, should be regarded as of paludal origin.

(*b*) *Pneumonia* is believed by many authors to be common in malaria, and even to depend directly upon the malarial poison, occurring either in the acute or in the chronic forms of the disease. I have no personal knowledge of such a special pneumonia.

(*c*) *Nephritis.*—Moderate albuminuria is a frequent occurrence, having occurred in 46.4 per cent. of the cases in my wards. Acute nephritis is relatively frequent in æstivo-autumnal infections, having occurred in over 4.5 per cent. of my cases. Chronic nephritis occasionally follows long-continued or frequently repeated infections.

Clinical Forms of Malarial Fever.—The relative frequency of the different forms varies in different regions. The tertian is the most common in temperate regions, the æstivo-autumnal in the tropics, the quartan is everywhere rare except in certain parts of India. In the Canal Zone the relative frequency of the different forms from 1904 to January 1st, 1910, was as follows: æstivo-autumnal, 22,089; tertian, 8,013; mixed infections, 677, and quartan, 20 cases. The quartan is relatively much more frequent in Baltimore; of 1,618 cases of malaria at my clinic, there were 15 instances (Thayer).

I. The Regularly Intermittent Fevers.—(*a*) Tertian fever; (*b*) quartan fever. These forms are characterized by recurring paroxysms of what is known as ague, in which, as a rule, chill, fever, and sweat follow each other in orderly sequence. The stage of *incubation* is not definitely

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known; it probably varies much according to the amount of the infectious material absorbed. Experimentally the period of incubation varies from thirty-six hours to fifteen days, being a trifle longer in quartan than in tertian infections. Attacks have been reported within a very short time after the apparent exposure. On the other hand, the ague may be, as is said, "in the system," and the patient may have a paroxysm months after he has removed from a malarial region, though of course this can not be the case unless he has had the disease when living there.

Description of the Paroxysm.—The patient generally knows he is going to have a chill a few hours before its advent by unpleasant feelings and uneasy sensations, sometimes by headache. The paroxysm is divided into three stages—cold, hot, and sweating.

Cold Stage.—The onset is indicated by a feeling of lassitude and a desire to yawn and stretch, by headache, uneasy sensations in the epigastrium, sometimes by nausea and vomiting. Even before the chill begins the thermometer indicates a rise in temperature. Gradually the patient begins to shiver, the face looks cold, and in the fully developed rigor the whole body shakes, the teeth chatter, and the movements may often be violent enough to shake the bed. Not only does the patient look cold and blue, but a surface thermometer will indicate a reduction of the skin temperature. On the other hand, the axillary or rectal temperature may, during the chill, be greatly increased, and, as shown in the chart, the fever may rise meanwhile even to 105° or 106°. Of symptoms associated with the chill, nausea and vomiting are common. There may be intense headache. The pulse is quick, small, and hard. The urine is increased in quantity. The chill lasts for a variable time, from ten or twelve minutes to an hour, or even longer.

The *hot stage* is ushered in by transient flushes of heat; gradually the coldness of the surface disappears and the skin becomes intensely hot. The contrast in the patient's appearance is striking: the face is flushed, the hands are congested, the skin is reddened, the pulse is full and bounding, the heart's action is forcible, and the patient may complain of a throbbing headache. There may be active delirium. One of my patients in this stage jumped through a ward window and sustained fatal injuries. The rectal temperature may not increase much during this stage; in fact, by the termination of the chill the fever may have reached its maximum. The duration of the hot stage varies from half an hour to three or four hours. The patient is intensely thirsty and drinks eagerly of cold water.

Sweating Stage.—Beads of perspiration appear upon the face and gradually the entire body is bathed in a copious sweat. The uncomfortable feeling associated with the fever disappears, the headache is relieved, and within an hour or two the paroxysm is over and the patient usually sinks into a refreshing sleep. The sweating varies much. It may be drenching in character or it may be slight.

Chart VI*a* is from a case of double tertian infection with resulting quotidian paroxysms. Charts VI*b* and VI*c* give temperature curves in æstivo-autumnal forms. Chart VI*d* shows a quartan ague.

The total duration of the paroxysm averages from ten to twelve hours, but may be shorter. Variations in the paroxysm are common. Thus the patient may, instead of a chill, experience only a slight feeling of coldness. The

most common variation is the occurrence of a hot stage alone, or with very slight sweating. During the paroxysm the spleen is enlarged and the edge can usually be felt below the costal margin. In the interval or intermission of the paroxysm the patient feels very well, and, unless the disease is unusually

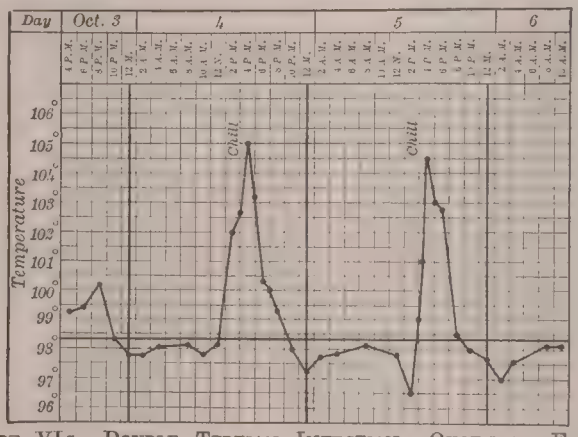

CHART VI*a*.—DOUBLE TERTIAN INFECTION.—QUOTIDIAN FEVER.

severe, he is able to be up. Bronchitis is a common symptom. Herpes, usually labial, is almost as frequent in malaria as in pneumonia.

Types of the Regularly Intermittent Fevers.—As has been stated in the description of the parasites, two distinct types of the regularly intermit-

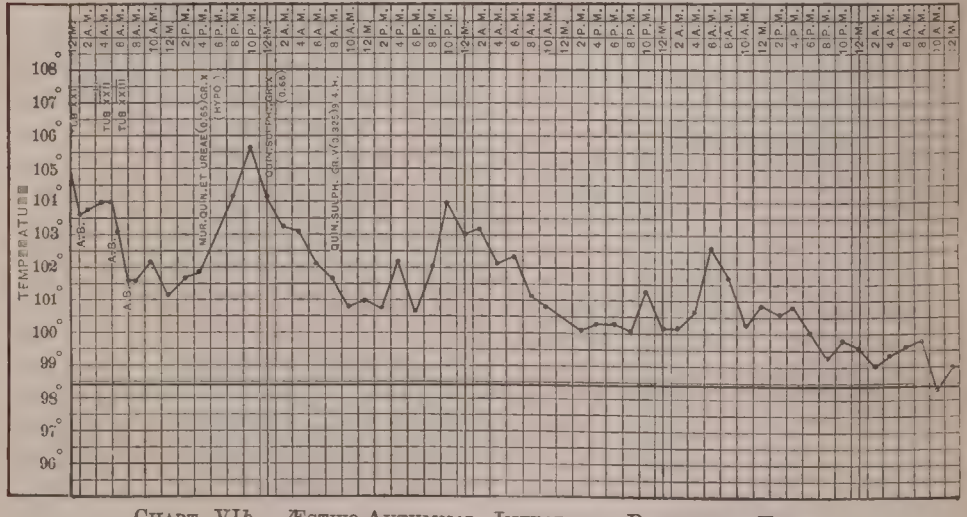

CHART VI*b*.—ÆSTIVO-AUTUMNAL INFECTION.—REMITTENT FEVER.
The case was treated for a week as one of typhoid fever.

tent fevers have been separated. These are (*a*) tertian fever and (*b*) quartan fever.

(*a*) Tertian Fever.—This type of fever depends upon the presence in the blood of the tertian parasite, an organism which, as stated above, is

usually present in sharply defined groups, whose cycle of development lasts approximately forty-eight hours, segmentation occurring every third day. In infections with one group of the tertian parasite the paroxysms occur synchronously with segmentation at remarkably regular intervals of about forty-

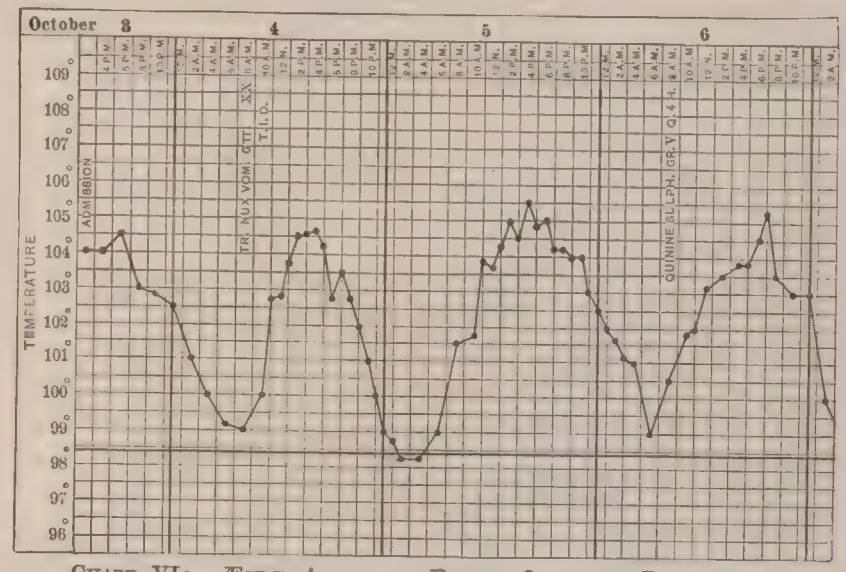

CHART VI*c*.—ÆSTIVO-AUTUMNAL FEVER.—QUOTIDIAN PAROXYSMS.

eight hours, every third day—hence the name *tertian*. Very commonly, however, there may be two groups of parasites which reach maturity on alternate days, resulting thus in daily (*quotidian*) paroxysms—*double tertian infection*.

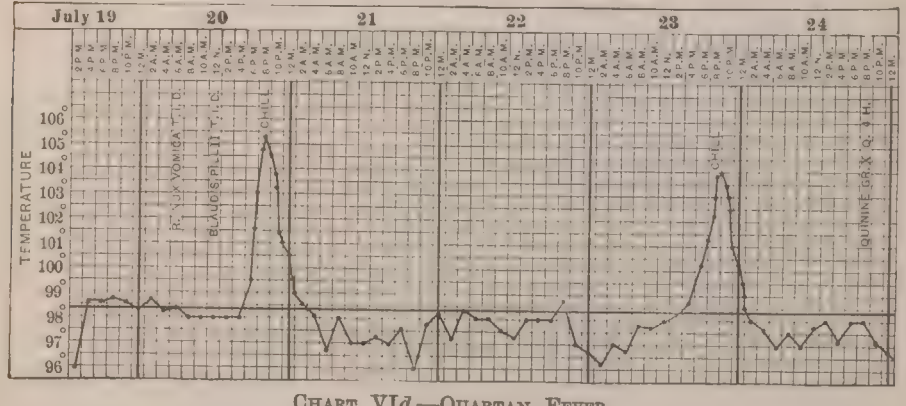

CHART VI*d*.—QUARTAN FEVER.

(*b*) Quartan Fever.—The symptoms resemble those of the tertian infection, but as a rule are milder. Paroxysms appear on the fourth day and correspond with the evolution of a parasitic cycle of seventy-two hours. In recent infections the recurrence of the paroxysm may be almost precisely the

same hour every fourth day. The infection may be double, in which case there are two paroxysms followed by a day of intermission, or triple, in which there is a daily paroxysm. As pointed out by the old Greek physicians, the quartan infection is very difficult to cure. Disappearing for a time spontaneously, or yielding promptly to quinine, it has a singular proneness to relapse, even after the most energetic treatment.

Thus a quotidian intermittent fever may be due to infection with either the tertian or quartan parasites.

Course of the Disease.—After a few paroxysms, or after the disease has persisted for ten days or two weeks, the patient may get well without any special medication. I have repeatedly known the chills to stop spontaneously. Relapses are common. The infection may persist for years, and an attack may follow an accident, an acute fever, or a surgical operation. A resting stage of the parasite has been suggested in explanation of these long intervals. Persistence of the fever leads to anæmia and hæmatogenous jaundice, owing to the destruction of blood cells. Ultimately the condition may become chronic—malarial cachexia.

II. The More Irregular, Remittent, or Continued Fevers.—(*a*) *Æstivo-autumnal Fever.*—This type of fever occurs in temperate climates, chiefly in the later summer and autumn; hence the term given to it by Marchiafava and Celli, *æstivo-autumnal fever*. The severer forms of it prevail in the Southern States and in tropical countries.

This type of fever is associated with the presence in the blood of the æstivo-autumnal parasite, an organism the length of whose cycle of development, ordinarily about forty-eight hours, is probably subject to considerable variations, while the existence of multiple groups of the parasite, or the absence of arrangement into definite groups, is not infrequent.

The *symptoms* are therefore, as might be expected, often irregular. In some instances there may be regular intermittent fever occurring at uncertain intervals of from twenty-four to forty-eight hours, or even more. In the cases with longer remissions the paroxysms are longer. Some of the quotidian intermittent cases may closely resemble the quotidian fever depending upon double tertian or triple quartan infection. Commonly, however, the paroxysms show material differences; their length averages over twenty hours, instead of from ten to twelve; the onset occurs often without chills and even without chilly sensations. The rise in temperature is frequently gradual and slow, instead of sudden, while the fall may occur by lysis instead of by crisis. There may be a marked tendency toward anticipation in the paroxysms, while frequently, from the anticipation of one paroxysm or the retardation of another, more or less continuous fever may result. Sometimes there is continuous fever without sharp paroxysms. In these cases of continuous and remittent fever the patient, seen fairly early in the disease, has a flushed face and looks ill. The tongue is furred, the pulse is full and bounding, but rarely dicrotic. The temperature may range from 102° to 103°, or is in some instances higher. The general appearance of the patient is strongly suggestive of typhoid fever—a suggestion still further borne out by the existence of acute splenic enlargement of moderate grade. As in intermittent fever, an initial bronchitis may be present. The course of these cases is variable. The fever may be continuous, with remissions more or

less marked; definite paroxysms with or without chills may occur, in which the temperature rises to 105° or 106°F. Intestinal symptoms are usually absent. A slight hæmatogenous jaundice may arise early. Delirium of a mild type may occur. The cases vary very greatly in severity. In some the fever subsides at the end of the week, and the practitioner is in doubt whether he has had to do with a mild typhoid or a simple febricula. In other instances the fever persists for from ten days to two weeks; there are marked remissions, perhaps chills, with a furred tongue and low delirium. Jaundice is not infrequent. These are the cases to which the terms *bilious remittent* and *typho-malarial* fevers are applied. In other instances the symptoms become grave and assume the character of the pernicious type. It is in this form of malarial fever that so much confusion still exists. The similarity of the cases to typhoid fever is most striking, more particularly the appearance of the faces; the patient *looks* very ill. The cases occur, too, in the autumn, at the very time when typhoid fever occurs. The fever yields, as a rule, promptly to quinine, though here and there cases are met with—rarely indeed in my experience—which are refractory. Several of the charts in Thayer and Hewetson's monograph show how closely, in some instances, the disease may simulate typhoid fever.

The *diagnosis* may be definitely made by the examination of the blood. Repeated examinations at short intervals may be required before the parasites are found. The small, actively motile, hyaline forms of the æstivo-autumnal parasite are to be found, while, if the course has been over a week, the larger crescentic and ovoid bodies are often seen. In many cases ~~in the tropics~~ one is unable to distinguish between typhoid and continued malarial fever without a blood examination.

(*b*) *Pernicious Malarial Fever.*—This is fortunately rare in temperate climates, and the number of cases which now occur, for example, in Philadelphia and Baltimore, is very much less than it was thirty or forty years ago. Pernicious fever is always associated with the æstivo-autumnal parasite. The following are the most important types:

(1) Comatose Form.—The comatose form, in which a patient is struck down with symptoms of the most intense cerebral disturbance, either acute delirium or, more frequently, a rapidly developing coma. A chill may or may not precede the attack. The fever is usually high, and the skin hot and dry. The ~~unconsciousness~~ may persist for from twelve to twenty-four hours, or the patient may sink and die. After regaining consciousness a second attack may come on and prove fatal. In these instances, ~~as has been stated~~, the special localization of the infection is in the brain, where actual thrombi of parasites with marked secondary changes in the surrounding tissues have been found.

(2) Algid Form.—In this the attack sets in usually with gastric symptoms; there are vomiting, intense prostration, and feebleness out of all proportion to the local disturbance. The patient complains of feeling cold, although there may be no actual chill. The temperature may be normal, or even subnormal; consciousness may be retained. The pulse is feeble and small, and the respirations are increased. There may be most severe diarrhœa, the attack assuming a choleriform nature. The urine is often diminished, or even suppressed. This condition may persist with slight exacerba-

tions of fever for several days and the patient may die in a condition of profound asthenia. This is essentially the same as described as the *asthenic* or *adynamic* form of the disease. In the cases with vomiting and diarrhœa the gastro-intestinal mucosa is often the seat of a special invasion by the parasites, actual thrombosis of the small vessels with superficial ulceration and necrosis occurring.

(3) Hæmorrhagic Forms—Black-water Fever—Hæmoglobinuric Fever—Malarial Hæmoglobinuria.—There are two types of hæmoglobinuria in malaria, the one associated with any severe pernicious malaria, in which an enormous number of red blood corpuscles are directly destroyed by parasites. Not very uncommon, we had a number of cases of this type at the Johns Hopkins Hospital. But in the true black-water fever there is a solution of red blood corpuscles by an unknown hæmolysin, not directly by the malarial parasites themselves.

The figures at Panama, based on five years' work at the Ancon Hospital, given by Deeks and James, show 230 cases in more than 40,000 cases of malaria. Their studies strongly favor the association of black-water fever with malaria, holding that there are three causes superadded to the previous malarial infection: (i) A renewed malarial attack with production of toxins sufficient to destroy many red blood corpuscles; (ii) a lowering of the bodily resistance; (iii) quinine, which appears to be the *tertium quid* necessary to produce the hæmolysin. The general experience at Panama is in favor of withholding quinine in the true erytholytic hæmoglobinuria. It is possible that we may find some measure to counteract the hæmolysis.

(*c*) *Malarial Cachexia.*—The general symptoms are those of secondary anæmia—breathlessness on exertion, œdema of the ankles, and hæmorrhages, particularly into the retina. Occasionally the bleeding is severe, and I have twice known fatal hæmatemesis to occur in association with the enlarged spleen. The fever is variable. The temperature may be low for days, not going above 99.5°. In other instances there may be irregular fever, and the temperature rises gradually to 102.5° or 103°F. With careful treatment the outlook is good, and a majority of cases recover. The spleen is gradually reduced in size, but it may take several months, or, indeed, in some instances several years, before the "ague-cake" entirely disappears.

Rarer Complications.—Paraplegia may be due to a peripheral neuritis or to changes in the cord, and hemiplegia may occur in the pernicious comatose form, or occasionally at the very height of a paroxysm. Acute ataxia has been described, and there are remarkable cases with the symptoms of disseminated sclerosis (Spiller). Multiple gangrene may occur, as in an instance reported by me, in which a patient with æstivo-autumnal infection presented many areas on the skin. *Orchitis* has been described by Charvot in Algiers and Fedeli in Rome.

Relapse.—It is not easy to explain the relapse. Some think there is a resting stage of the parasite which remains in the spleen or the bone marrow. Schaudinn believed that there is a special parthenogenetic form which may remain latent for an indefinite period. This seems most likely, as there can be no question that months or even years may elapse between the pri-

mary infection and a relapse occurring under conditions that preclude the possibility of re-infection.

Diagnosis.—The endemic index of a country may be determined by the "parasite rate" or by the "spleen rate." It is best sought for in children, in whom, as is well known, the infection may occur without much disturbance of the health. To determine the index by examining the blood for the parasites is a laborious and almost impossible task; on the other hand, as the work of Ross in Greece and Mauritius has shown, the index may be readily gauged by an examination of the spleen. Thus, in the last-named island, of 31,022 children, 34.1 per cent. had enlarged spleen. In Bombay, among 50,000 children examined, the spleen index varied from 5.3 per cent. in the Hindoos to 23.2 per cent. in the Parsees (Bentley).

The individual forms of malarial infection are readily recognized, but it requires a long and careful training to become an expert in blood examination. Great progress has been made ~~in the past twenty years~~, and a diagnosis of malaria is no longer a refuge for our ignorance. One lesson it is hard for the practitioner to learn—namely, that an intermittent fever which resists quinine is not malarial.

The malarial poison is supposed to influence many affections in a remarkable way, giving to them a paroxysmal character. A whole series of minor ailments and some more severe ones, such as neuralgia, are attributed to certain occult effects of paludism. The more closely such cases are investigated the less definite appears the connection with malaria.

Prophylaxis.—In the discovery of Laveran there lay the promise of benefits more potent than any gift science had ever offered to mankind—viz., the possibility of the extermination of malaria. By the persistent missionary efforts of Ross this promise has reached the stage of practical fulfilment, and one of the greatest scourges of the race is now under our command. The story of the Canal Zone, Panama, under Colonel Gorgas is a triumph of the application of scientific methods. Between 1881 and 1904 among the employees of the French Canal Company (a maximum in 1887 of 17,995, of whom 15,726 were negroes) the monthly mortality ranged from 60 to 70, and on seven occasions was above 100, once reaching the enormous figure of 176.97 per 1,000. With the measures given below, the mortality has fallen below that of temperate regions. For the year 1910 the death rate among 50,802 employees was, total deaths 558, from disease 381, from violence 177; the death rate from disease was 7.5 per 1,000. In August, 1911, among 49,710 employees the death rate from disease was 6.27!

This most successful campaign has been carried out on the following lines: (1) The eradication of mosquito propagation areas by drainage, and the filling of places where the larvæ exist. This has been done successfully in large districts.

(2) The control of propagation areas that are allowed to exist, or that cannot be economically and permanently treated. On small areas the larvæ are prevented from arriving at the adult stage by the use of crude oil or kerosene, and in large bodies of water by treating the edges where alone the mosquito larvæ exist. A concentrated larvacide of carbolic acid, resin, and caustic soda, so made as to form an emulsion with the water into which it is placed, has been found effective, when applied to the edges of large pools, ditches, wet

areas and streams. A barrel of oil with an automatic drip at the head of a stream has been found to work satisfactorily.

(3) Protection by screening of houses. On the Zone all the houses occupied by Americans are protected by copper-bronze screens of 18 mesh to the inch. Cotton bar treated with wax is also recommended as inexpensive. Screened vestibules decrease the chance of access of mosquitoes. Mosquito nets over the beds are found, as a rule, to be a failure, chiefly because few persons sleep through a whole night without an arm or leg coming in contact with the netting on which the anopheles settle.

(4) The destruction of adult anopheles. In two sets of barracks not far apart, with many anopheles, in one all the adult mosquitoes were killed daily, in the other they were not; in the latter during a period of several months there was forty-two times as much malaria. The mosquitoes are easily caught; they are usually in the corners, and very often within a foot of the floor.

Of the enormous importance of these anti-malarial measures there can now be no question. It requires system, organization, energy and perseverance. But the story of Havana, where malaria no longer exists, and the story of Ismalia, and, above all, the story of the Panama Canal Zone show what can be done. The following chart, taken from an article of Le Prince, the chief sanitary inspector of the Zone, gives a good idea of the results. The objection offered on the score of cost in the tropics has been shown by Gorgas to be fallacious.

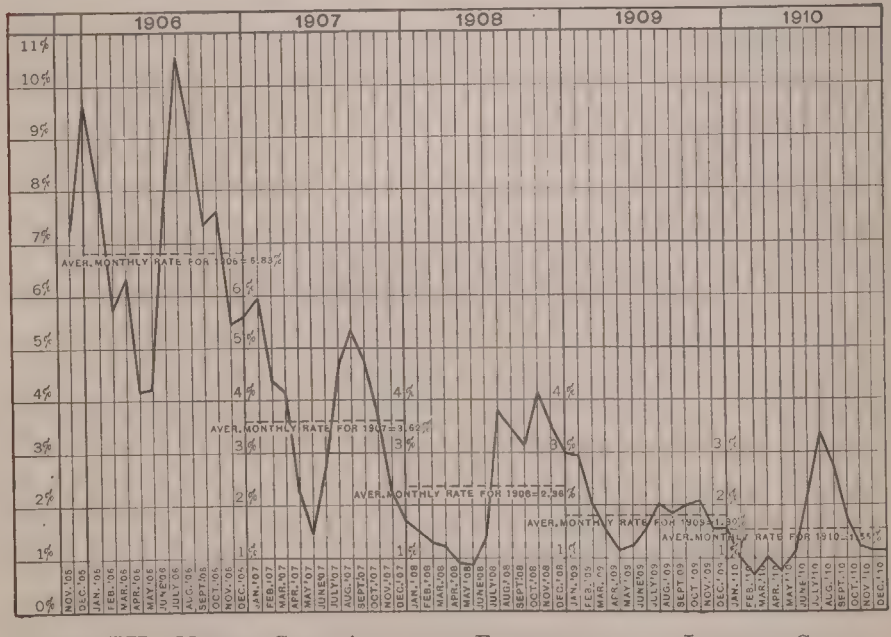

CHART VII.—MALARIA CASES AMONG THE EMPLOYEES OF THE ISTHMIAN CANAL COMMISSION, 1906-1910.

Every patient with malaria should be regarded as a centre of infection, and in a systematic warfare reported to the health authorities. In the tropics segregation of Europeans may do much to lessen the chances of infection.

Every patient should receive thorough and prolonged treatment with quinine. There is far too much carelessness on this point in the profession. Malarial infection is a difficult one to eradicate. Quinine is the only known drug which is an effective parasiticide. Patients should be told to resume the treatment in the spring and autumn for several years after the primary infection. In very malarial districts, as many persons harbor the parasites who do not show any (or at the most very few) signs, a systematic treatment with quinine should be instituted, particularly of the young children.

Patients with the disease should be protected from mosquitoes as far as possible. As a rule, anopheles are more likely to bite after sundown, so that in regions in which the disease prevails extensively mosquito netting should be used. Persons going to a malarial region should take about 10 grains (0.6 gm.) of quinine daily, though Sézary found that 2 grains (0.13 gm.) three times a day was a sufficient protection against the disease.

Treatment.—The patient should be in bed and given liquid or soft diet. The bowels should be moved freely, for which a calomel and saline purge is best. In quinine we possess a specific remedy against malarial infection. Experiment has shown that the parasites are most easily destroyed by quinine at the stage when they are free in the circulation—that is, during and just after segmentation. While in most instances the parasites of the regularly intermittent fevers may be destroyed, even in the intra-corpuscular stage, in æstivo-autumnal fever this is much more difficult. It should, then, be our object, ~~if we wish to most effectively eradicate the infection,~~ to have as much quinine in circulation at the time of the paroxysm and shortly before as is possible, for this is the period at which segmentation occurs. In the regularly intermittent fevers from 10 to 30 grains (0.6 to 2 gm.) in divided doses throughout the day will in many instances prevent any fresh paroxysms. If the patient comes under observation shortly before an expected paroxysm, the administration of a good dose of quinine just before its onset may be advisable to obtain a maximum effect upon the group of parasites. The quinine will not prevent the paroxysm, but will destroy the greater part of the group of organisms and prevent its recurrence. It is safer to give at least 20 to 30 grains (1.3 to 2 gm.) daily for the first three days, and then to continue the remedy in smaller doses for the next two or three weeks. In æstivo-autumnal fever larger doses may be necessary, though in relatively few instances is it necessary to give more than 30 grains (2 gm.) in the twenty-four hours. During the paroxysm the patient should, in the cold stage, be wrapped in blankets and given hot drinks. The reactionary fever is rarely dangerous even if it reaches a high grade. The body may, however, be sponged.

The quinine should be ordered in solution or in capsules. The pills and compressed tablets are more uncertain, as they may not be dissolved. Euquinin, in the same dosage, may be given to patients with whom quinine disagrees.

A question of interest is the efficient dose of quinine necessary to cure the disease. I have a number of charts showing that grain doses three times a day will in many cases prevent the paroxysm, but not always with the certainty of larger doses. In cases of æstivo-autumnal fever with pernicious symptoms it is necessary to get the system under the influence of quinine as rapidly as possible. In these instances the drug should be administered by

injection into the muscles, as the dihydrochlorate in ten-grain (0.6 gm.) doses, in a freshly prepared solution (1 to 2) in sterile water and repeated in two hours. Further administration must be decided by the condition. The muriate of quinine and urea is also a good form in which to administer the drug hypodermically; 10-grain (0.6 gm.) doses may be given. In the most severe instances some observers advise the intravenous administration of quinine, for which the very soluble bimuriate is well adapted. Fifteen grains with 40 grains of sodium chloride may be injected in ten ounces of freshly distilled water. The intravenous administration is not without danger. For extreme restlessness in these cases opium is indicated, and cardiac stimulants, such as alcohol and strychnine, may be necessary. If in the comatose form the internal temperature is raised, the patient should be sponged or given a tub bath. For malarial anæmia iron and arsenic are indicated.

An interesting question is much discussed, whether quinine does not cause, or at any rate aggravate, hæmoglobinuria. We have not yet seen a case in which this condition has occurred as a result of the use of the drug, and Bastianelli states that it is not seen in the Roman malarial fevers. In any case of hæmoglobinuria if the blood shows parasites quinine should be administered cautiously. In the post-malarial forms quinine aggravates the attack. In an active malarial infection the patient runs less risk with the quinine.

In malarial cachexia the patient should have a change of climate, be given a liberal diet, and take quinine in small doses and iron and arsenic for some time.

IV. TRYPANOSOMIASIS

Definition.—A chronic disorder characterized by fever, lassitude, weakness, wasting, and often a protracted lethargy—sleeping sickness. *Trypanosoma gambiense* is the active agent in the disease.

Trypanosomes are flagellate infusoria, parasitic in a great many invertebrate and vertebrates. The life history is in two stages, a flagellate monadine phase, in which they live in the blood stream of vertebrates and in some of which they cause serious disease; the other is a gregarine non-flagellate phase which may also be parasitic and which is met with in forms of Kala-Azar.

History.—In 1843 Gruby found a blood parasite in the frog which he called *Trypanosoma sanguinis.* Subsequently it was found to be a very common blood parasite in fishes and birds. In 1878 Lewis found it in the rat—*T. lewisi*—in which it apparently does no harm. The pathological significance of the protozoa was first suggested in 1880 by Griffith Evans, who discovered *trypanosomes—T. evansi*—in the disease of horses and cattle in India known as *surra.* In 1895 Bruce made the important announcement that the tsetze fly disease or *nagana* of South Africa, which made whole districts impassable for cattle and horses, was really due to a trypanosome—*T. brucei.* Normally present in the blood of the big-game animals of the districts, and doing them no harm, it was conveyed by the tsetze fly to the non-immune horses and cattle imported into what were called the fly-belts. Other trypanosomes are the Philippine surra, studied by Musgrave, the *mal de caderas—T. equinum*—of South America and a harmless infection in cattle in the Transvaal caused by *Trypanosoma theileri.*

T. cruzi – (same spec. mentioned by Mazza)

T. rhodesiense – may be identical with T. brucei

Human Trypanosomiasis.—In 1901 Dutton found a trypanosome in the blood of a West Indian. In 1903 Castellani found trypanosomes in the cerebro-spinal fluid and in the blood of five cases of the African sleeping sickness. The Royal Society Commission (Bruce and Nabarro) demonstrated the great frequency of the parasites in the cerebro-spinal fluid and in the blood in sleeping sickness, and suggested that it was a sort of human tsetze fly infection.

Distribution.—For many years it had been known that the West African natives were subject to a remarkable malady known as the lethargy or sleeping sickness. It was also met with among the slaves imported into America. The demonstration of the association of the trypanosomes with the terrible sleeping sickness has been the most important recent "find" in tropical medicine. The disease prevails in Gambia, Sierra Leone, and Liberia, and is spreading rapidly in the Congo basin, Uganda, and Rhodesia. The ~~recent~~ opening up of equatorial Africa has led to intercommunication between ~~the different~~ districts which were formerly isolated, and the seriousness of the disease may be appreciated from the fact that within three years after its introduction 100,000 negroes died of it in Uganda. In the infected regions a large number of natives, not apparently suffering from the disease, harbor the parasites in the blood and suffer only with occasional attacks of fever, during which the trypanosomes are also found in the cerebro-spinal fluid.

The disease is not confined to negroes, and Europeans may be attacked. Persons particularly prone are those who live on the wooded shores of the lakes and rivers, such as fishermen and canoe men.

The parasite is introduced by the bite of a fly, the *Glossina palpalis*, and where this insect exists the disease is liable to prevail. The fly lives on the bushes on the lake shores or river banks, and feeds on the blood of crocodiles, antelopes, etc. The trypanosomes undergo changes in the body of the fly and the infectivity does not appear until the thirty-second day, but continues for at least 75 days (Bruce).

Symptoms.—There is stated to be a long latent period. The Uganda Commissioners divide the course of the disease into three stages: first, of fever with rapid pulse, dulling of the mind, and loss of weight; secondly, the stage of tremors in which the gait becomes shuffling, the speech slow, and there are tremors of the tongue and of the hands and feet; lastly, a stage in which the patient becomes lethargic with low temperature and presents the typical picture of the dreaded sleeping sickness. The parasites are found in the cerebro-spinal fluid, less constantly in the blood. In the early stages the glands of the neck are involved, and Todd and Dutton recommend puncture of these glands for the purpose of diagnosis. Death is usually caused by some intercurrent infection, as purulent meningitis or suppuration of the lymph glands. The duration is seldom longer than eighteen months. To stay the ravages and prevent the spread of the disease will tax the energies of the nations interested in the settlement of tropical Africa. The hope appears to be in the extermination of the animals upon which the *Glossina palpalis* feeds, ~~(among which Koch holds the crocodile to be the most important)~~, just as the killing off of the big game in other parts of Africa has saved the cattle from the ravages of the tsetze fly. Though a colossal task, the examination of natives of in-

fected districts should be undertaken, isolation villages established, and the cases kept under observation and treatment.

Prognosis.—Nine cases in Europeans have been cured, and six of these have been without symptoms from three and one-half to seven years. The criteria of cure are the absence of symptoms, failure to find the trypanosomes, the absence of auto-agglutination, and negative inoculation of the blood into susceptible animals.

Treatment.—Atoxyl introduced by Wolferstan Thomas and Breinl appears to have given the most satisfactory results. The parasites seem to vary in their resistance to arsenic. In some places the arsenophenylglycin seems to have acted almost as a specific. Antimony has been used a good deal ~~of late,~~ and Kerandel, a member of the French Commission, ~~has~~ cured himself with it, injecting intravenously on successive days a solution of tartar emetic in seventeen 10-centigram doses. Salvarsan has been used with benefit, but we have not yet a full knowledge of its effects.

V. LEISHMANIASIS

(*Kala-Azar*)

Definition.—Leishmaniasis is an affection caused by parasites of the Leishmania group, of which there are three chief forms: the *Indian kala-azar,* the *infantile kala-azar,* and *tropical sore.*

Indian Kala-Azar.—An affection characterized by enlarged spleen, anæmia and irregularly remittent fever. Leishman in 1900 discovered the parasite, which was subsequently studied by Donovan. It is a protozoon of very constant form, living in the ~~cells of the~~ spleen and bone-marrow. It has been successfully cultivated by Rogers and others, and develops into a flagellate form.

Distribution.—The disease is widely spread in Asia, particularly in Assam, many parts of India, Burma, Indo-China, Ceylon and Syria. Europeans contract it rarely.

Etiology.—Rogers believes the bedbug of India is the chief agent in transmitting it, a view which Patton shares, as he found the ingested parasite in the bedbug underwent development into flagellate forms. Donovan suggests that the disease is transmitted by the plant-feeding bug, the conorrhinus, which is an occasional blood-sucker.

Symptoms.—Enlargement of the spleen is almost constant; there is irregular fever, which lasts for months and is sometimes characterized by a double rise in the twenty-four hours. The other features are those of a progressive anæmia of a secondary type. Recovery is possible, but the mortality is above 80 per cent.

Infantile Kala-Azar.—This form, separated by Nicole and his associates at Tunis, is the infantile splenic anæmia long recognized in the countries of the Mediterranean basin. It differs from the Indian form in attacking children almost exclusively, and in the presence of a parasite which differs from the *L. donovani,* and which is known as the *L. infantum.* Another special feature is that the disease may be reproduced in dogs and monkeys and a spontaneous infection of dogs exists in the endemic areas of infantile Kala-

antimony. tartar emetic. 1% soln. cannot be distinguished by heat. through filter. 5cc. of 1% soln. prior dose. then 10cc. by call does if welborn. biliousness.

Hannan gives morphine (M)

Azar. Observations strongly suggest that the disease is transmitted to children through the dog flea, or through the human flea having bitten an infected dog.

Tropical Sore.—Under the various names Aleppo boil, Delhi boil, Bagdad sore, Nile sore and many others, has been described a form of disease characterized by ulcerating and non-ulcerating lesions, almost always on the exposed parts of the body. The parasite discovered by Homer Wright and known as *Leishmania tropica* has very much the same characters as the other forms, but there are slight differences, morphological and cultural. The mode of transmission has not been definitely determined.

Treatment.—For Indian kala-azar not much can be done. Quinine given in the ordinary way seems useless, but from hypodermic injections into the muscles good results are reported. Atoxyl has been freely used. In some regions the natives insert a dirty seton in the region of the spleen. Both for this and the infantile form salvarsan has been used, but with doubtful benefit. For the tropical sore dusting with potassium permanganate, and a few days later applying a 10 per cent. solution of Prussian blue, has been found useful.

VI. RELAPSING FEVER

(*Febris recurrens*)

Definition.—A group of specific infections caused by spirochætes, characterized by febrile paroxysms which usually last five or six days with remissions of about the same length of time. The paroxysms may be repeated three or even four times, whence the name relapsing, or recurring, fever. European, Indian, American and African forms are described presenting clinically much the same features, but the parasites differ in certain peculiarities.

Etiology.—The European form, which has also the name "famine fever" and "seven-day fever," has been known since the early part of the eighteenth century, and has from time to time extensively prevailed, especially in Ireland. It is a very rare disease in England. In the United States the disease appeared in 1844, when cases were admitted to the Philadelphia Hospital, which are described by Meredith Clymer in his work on Fevers. Flint saw cases in 1850-'51. In 1869 it prevailed extensively in epidemic form in New York and Philadelphia; since when it has not reappeared. While clinically the same as the European form, the organism is different and has been called *S. novyi.*

In India, where the disease is very prevalent, the parasite called after Vandyke Carter, differs from the spirochæte of Obermeier. Possibly it may be transmitted by mosquitoes as well as bugs.

The *African relapsing fever,* known as *tick fever,* is a very serious and widespread affection, the parasite of which, *S. duttoni,* is distinct from the other forms. It is transmitted by the tick *Ornithodoros monbata,* but as Leishman has shown, not by direct inoculation with the salivary secretion, but from other secretions voided in the act of gorging. The symptoms are very similar to those of European relapsing fever, and as many as from five to seven relapses may take place. The mortality is not very high.

The *Spirillum* or spirochæte, described by Obermeier in 1873, was one of the first micro-organisms shown to be definitely associated with a specific fever. It is from 15 to 40 μ. in length, spirally arranged like a corkscrew, sometimes curved and twisted. The ends are tapering; whether furnished with flagella or not is doubtful. It is actively motile, and it is present in the blood during the febrile paroxysm, disappearing at intervals.

The mode of transmission ~~of the disease~~ is probably through lice and bed bugs. The disease has been reproduced by injecting into a healthy monkey blood sucked by a bug from an infected animal. The special conditions under which it occurs are similar to those of typhus fever. Neither age, sex, nor season seems to have any special influence. One attack does not confer immunity, ~~from subsequent attacks~~.

Morbid Anatomy.—There are no characteristic anatomical appearances in relapsing fever. If death takes place during the paroxysm the spleen is large and soft, and the liver, kidneys and heart show cloudy swelling. There may be infarcts in the kidneys and spleen. The bone-marrow has been found in a condition of hyperplasia. Ecchymoses are not uncommon.

Symptoms.—The *incubation* appears to be short; in some instances the attack occurs within twelve hours after exposure; more frequently, however, from five to seven days elapse.

The *invasion* is abrupt, with chill, fever, and intense pain in the back and limbs. In young persons there may be nausea, vomiting, and convulsions. The temperature rises rapidly and may reach 104° on the evening of the first day. Sweats are common. The pulse is rapid, ranging from 110 to 130. There may be delirium if the fever is high. Swelling of the spleen can be detected early. Jaundice is common in some epidemics. The gastric symptoms may be severe, but there are seldom intestinal symptoms. Cough may

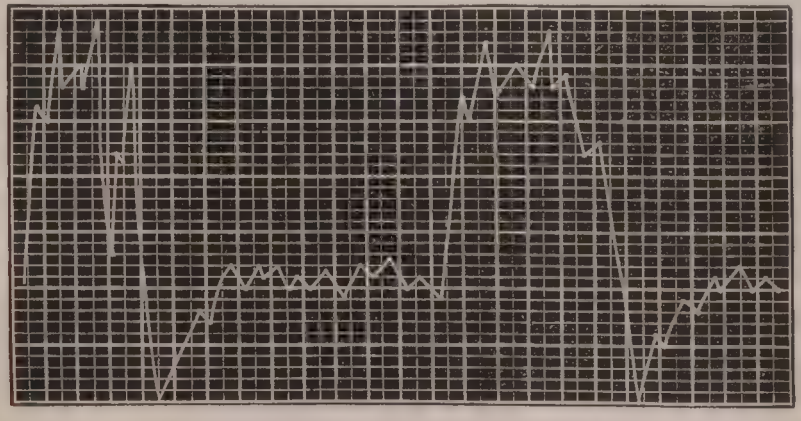

CHART VIII.—RELAPSING FEVER (Murchison).

be present. Occasionally herpes is noted, and there may be miliary vesicles and petechiæ. During the paroxysm the blood invariably shows the spirochæte, and there is usually a leucocytosis. After the fever has persisted with severity or even with an increasing intensity for five or six days the crisis occurs. In the course of a few hours, accompanied by profuse sweating, some-

S. recuncultés - (Obermeyer ou Obermeier?)

times by diarrhœa, the temperature falls to normal or even subnormal, and the period of apyrexia begins.

The crisis may occur as early as the third day, or it may be delayed to the tenth; it usually comes, however, about the end of the first week. In delicate and elderly persons there may be collapse. The convalescence is rapid, and in a few days the patient is up and about. Then in a week, usually on the fourteenth day, he again has a rigor, or a series of chills; the fever returns and the attack is repeated. A second crisis occurs from the twentieth to the twenty-third day, and again the patient recovers rapidly. As a rule, the relapse is shorter than the original attack. A second and a third may occur, and there are instances on record of even a fourth and a fifth. In epidemics there are cases which terminate by crisis on the seventh or eighth day without the occurrence of relapse. In protracted cases the convalescence is very tedious, as the patient is much exhausted.

Relapsing fever is not a very fatal disease. Murchison states that the mortality is about 4 per cent., but it has been as high as 30 per cent. in India. In the enfeebled and old, death may occur at the height of the first paroxysm.

Complications are not frequent. In some epidemics hæmatemesis and hæmaturia have occurred. Pneumonia is not infrequent. The acute enlargement of the spleen may end in rupture. Post-febrile paralyses may occur. Ophthalmia has followed in certain epidemics, and may prove a very tedious and serious complication. In pregnant women abortion usually takes place. Convulsions occasionally follow. Dutton, the well-known worker on tropical diseases, died in *status epilepticus* some weeks after the attack.

Diagnosis.—The onset and general symptoms may not at first be distinctive. At the beginning of an epidemic the cases are usually regarded as anomalous typhoid; but once the typical course is followed in a case the diagnosis is clear. The blood examination is distinctive.

Prophylaxis.—As overcrowding is an important element in the transmission, the patient should be isolated. The bedding, clothing, and dwellings of infected persons should be thoroughly disinfected and care taken that all cracks and crevices in woodwork which may harbor bedbugs are treated with disinfectants.

Treatment.—The paroxysm can neither be cut short nor can its recurrence be prevented. The disease must be treated like any other continued fever, by careful nursing, a regular diet, and ordinary hygienic measures. Of special symptoms, pain in the back and in the limbs and joints demands opium. In enfeebled persons the collapse at the crisis may be serious, and stimulants with ammonia and digitalis should be given freely. The arsenical preparations may be tried, but they have not been very successful.

VII. SYPHILIS

I. HISTORY, ETIOLOGY AND MORBID ANATOMY

Definition.—A specific disease of slow evolution caused by *Treponema pallidum*, propagated by inoculation (acquired syphilis) or transmission through the mother (congenital syphilis).

History.—Whether the disease was known in Europe before 1493 is still discussed. Block, in the System of Syphilis, Vol. I, 1908, insists that there is no evidence of pre-Columbian syphilis in the Eastern hemisphere before the return of the Spanish sailors from Hayti, from whom it spread among the inhabitants of Barcelona. In 1493 it reached Italy with the army of Charles VIII. His soldiers syphilized Naples; the disease spread throughout Italy, and in a few years Europe was aflame. On the other hand, writers who contend for the antiquity of the disease in Asia and Europe rely on certain old Chinese records, on references in the Bible and in old medical writers to diseases resembling syphilis and on suggestive bone lesions in very old skeletons. The balance of evidence, according to the best syphilographers, is in favor of the American origin. At first it was called the Neapolitan disease, the French pox, or Morbus Gallicus; and in 1530 Fracastorius, in a poem entitled "Syphilis sive Morbus Gallicus," gave it the name by which it is now commonly known. The etymology of the name is uncertain.

At first the disease was thought to be transmitted like any other epidemic, but gradually the venereal nature was recognized, and Fernel, a famous Paris physician of the 16th century, insisted on the necessity of a primary inoculation. Paracelsus observed its ~~hereditary~~ character. Throughout the 16th century the symptoms were well described. The disease appears to have been of much greater severity then than at present. Mercury and guaiacum were introduced as the important remedies. In the 18th century Lancisi recognized the relations existing between syphilis and aneurism, and Morgagni described many of the visceral lesions. Hunter, misled by inoculations made on his own person, decided in favor of the unity of the venereal poisons, gonorrhœa, soft chancre and syphilis. Ricord clearly differentiated the soft and hard chancre, and throughout the 19th century the clinical and pathological lesions were so thoroughly studied that scarcely a feature of the disease remained unknown. But all efforts at discovering the cause had failed, until in 1905 Schaudinn demonstrated the presence of a spirochæte in the lesions. Since then his work has been amply verified, and in 1910 Ehrlich announced the discovery of a compound which would destroy the parasite and not damage the individual.

Etiology: The Parasite.—The treponema is a spiral, curved organism from 5 to 15 μ in length, showing active movements in fresh specimens. It is present in the primary sore, in the regional lymph glands, in the secondary lesions, in many gummata, and in special abundance in the congenital lesions, particularly in the liver. Its presence in the body has been demonstrated as long as 15 to 20 years after the primary infection. It is inoculable into monkeys, with the production of a disease resembling in most particulars that of man. The parasite has been successfully cultivated by Noguchi.

One of the most important results of the discovery of the parasite has been the application of the newer methods of serum diagnosis. What is called the Wassermann reaction is a special way of determining the presence of immune bodies in the blood of a patient suffering from any syphilitic infection. An enormous amount of work has been done upon it ~~within the past few years~~, with the general result of confirming its value ~~in diagnosis~~. A positive result has been obtained in ~~from~~ 90 to 95 per cent. of all cases. It appears from the end of the second to the end of the fourth week, becomes

congenital

Spiro[illegible] - various strains. It may undergo modification in vivo. Hence perhaps reason for reduced incidence of taken of S.P. in women.
S. pneb. produces self-destructive antibodies in human body. a few S pneumo - rebounds & more antibodies than [illegible] resistance & condition than guinea pig. Syphilis stage perhaps has immunity to usual remedies.
So in vitro - strains show diff - e.g. Spirochaetes from S.P. take 60-80 days for transformation. 160 days for lesions to be reduced [illegible] between early stages 3-4 weeks enough.
Can give spirochete with diff - effects in various channels & secondaries
Lymphoid. Schaud. Hoffm

more marked and may continue for an indefinite period. During active treatment it may be absent, to reappear again. Its intensity bears some relation to the activity of the lesions. A positive result has been found in a large proportion of cases of locomotor ataxia, and ~~in paralysis of the insane~~. paresis

Modes of Infection.—(*a*) In a large majority of ~~all~~ cases the disease is transmitted by *sexual congress,* but the designation *venereal* disease (*lues venerea*) is not always correct, as there are many other modes of inoculation. In the St. Louis Hospital collection there are illustrations of 26 varieties of extragenital chancres.

(*b*) *Accidental Infection.*—In surgical and in midwifery practice physicians are not infrequently inoculated. General infection may occur without a characteristic local sore. Midwifery chancres are usually on the fingers, but they may be on the back of the hand. The lip chancre is the most common of these erratic or extra-genital forms, and may be acquired in many ways apart from direct infection. Mouth and tonsillar sores result as a rule from improper practices. Wet-nurses are sometimes infected on the nipple, and it occasionally happens that relatives of a syphilitic child are accidentally contaminated.

(*c*) *Congenital Transmission.*—The disease is not directly inherited, but the fetus is infected through the placenta. It is a question entirely of intrauterine infection. The mother herself may be, and often is, apparently quite healthy, but, as recent observations have shown, the Wassermann reaction is present and it is through her and not directly through the father that the disease is transmitted. We can now understand what is known as Beaumès' or Colles' law, which was thus stated by the distinguished Dublin surgeon: "That a child born of a mother who is without obvious venereal symptoms, and which, without being exposed to any infection subsequent to its birth, shows this disease when a few weeks old, this child will infect the most healthy nurse, whether she suckle it, or merely handle and dress it; and yet this child is never known to infect its own mother, even though she suckle it while it has venereal ulcers of the lips and tongue." So, too, a child showing no taint, but born of a woman suffering with syphilis, may with impunity be suckled by its mother (Profeta's law).

Morbid Anatomy.—The *primary lesion*, or chancre, shows: (*a*) A diffuse infiltration of the connective tissue with small, round cells. (*b*) Larger epithelioid cells. (*c*) Giant cells. (*d*) Changes in the small arteries and veins, chiefly thickening of the intima, and alterations in the nerve fibres going to the part. The sclerosis is due in part to this acute obliterative endarteritis. Associated with the initial lesions are changes in the adjacent lymph glands, which undergo hyperplasia, and finally become indurated.

The *secondary lesions* of syphilis are too varied for description here. They consist of condylomata, skin eruptions, affections of the eye, etc.

The *tertiary lesions* consist of circumscribed tumors known as gummata, various skin lesions, and a special type of arteritis.

Gummata.—Syphilomata occur in the bones or periosteum—here they are called nodes—in the muscles, skin, brain, lungs, liver, kidneys, heart, testes, and adrenals. They vary in size from small, almost microscopic bodies to large solid tumors from 3 to 5 cm. in diameter. They are usually firm and hard, but in the skin and on the mucous membranes they tend to break down

rapidly and ulcerate. On cross-section a medium-sized gumma has a grayish-white, homogeneous appearance, presenting in the centre a firm, caseous substance, and at the periphery a translucent, fibrous tissue. Often there are groups of three or more surrounded by dense sclerotic tissue.

The arteritis will be considered in a separate section.

II. ACQUIRED SYPHILIS

Primary Stage.—This extends from the appearance of the initial sore until the onset of the constitutional symptoms, and has a variable duration of from six to twelve weeks. The initial sore appears within a month after inoculation, and it first shows itself as a small red papule, which gradually enlarges and breaks in the centre, leaving a small ulcer. The tissue about this becomes indurated so that it ultimately has a gristly, cartilaginous consistence—hence the name, hard or indurated chancre. The size attained is variable, and when small the sore may be overlooked, particularly if it is just within the urethra. The initial lesion has no invariable characteristic and may not be indurated. Syphilitic infection may occur with a chancroid. The glands in the lymph-district of the chancre enlarge and become hard. Suppuration both in the initial lesion and in the glands may occur as a secondary change. The general condition of the patient in this stage is good. There may be no fever and no impairment of health.

Secondary Stage.—The first constitutional symptoms are usually manifested within three months of the appearance of the primary sore. They rarely occur earlier than the sixth or later than the twelfth week:

(*a*) *Fever,* slight or intense, and very variable in character, may occur early before the skin rash; more frequently it is the "fever of invasion" with the secondary symptoms, or the fever may occur at any period. It may be a mild continuous pyrexia, or in other instances with marked remissions, but the most remarkable form is the intermittent, often mistaken for malaria. ~~Such cases have been reported by Yeo and by Sidney Phillips~~. The fever may reach 105° and the paroxysms persist for months. I have had several cases in which typhoid fever was suspected, and in others tuberculosis.

(*b*) *Anæmia.*—In many cases the syphilitic poison causes a pronounced anæmia which gives to the face a muddy pallor, and there may even be a light-yellow tinging of the conjunctivæ or of the skin, a hæmatogenous icterus. This syphilitic cachexia may in some instances be extreme. The red blood corpuscles do not show any special alterations. The blood count may fall to three millions per cubic millimetre, or even lower. The anæmia may come on suddenly. In a case of syphilitic arthritis in a young girl, following three or four inunctions of mercury, the blood-count fell below two millions per cubic millimetre in a few days.

(*c*) *Cutaneous Lesions.*—The earliest and most common is a *macular syphilide* or *syphilitic roseola,* which occurs on the trunk, and on the front of the arms. The face is often exempt. The spots, which are reddish-brown and symmetrically arranged, persist for a week or two. There may be multiple relapses of roseola, sometimes at long intervals, even eleven years (Fournier). The *papular syphilide,* which forms acne-like indurations about the face and trunk, is often arranged in groups. Other forms are the *pustular*

Leukoplakia ac [illegible]

chancre - nuclein & epidermis - [illegible]

Spinc. R. Hunt. Ann-Jour. 1914. 148. 164

excostoses, gummatous periostitis; osteo-myelitis occas. meningeal
→ metast tertiary -
Sympts - pain, tenderness, rigidity, deformity -
→, espec. in cervical spine -
cerebro-spinal.

neural sympts. in 26 of 100 cases. 15 cervical & lumb.
5 dorsal. 2 sacral

root pains, suggest pachymeningitis cervicalis hypertrophica.

absence of large + common (esp. in sero. cases)

Met - sudden onset.

of 100 cases 25 same nervous syst. complications (cord 2/3 rest spinal)

J. A. M. A. Dec 11. 1915 -

rash, which may so closely simulate variola that the patient may be sent to a small-pox hospital. A *squamous syphilide* occurs, not unlike ordinary psoriasis, except that the scales are less abundant. The rash is more copper-colored and not specially confined to the extensor surfaces.

In the moist regions of the skin, such as the perineum and groins, the axillæ, between the toes, and at the angles of the mouth, the so-called *mucous patches occur*, which are flat, warty outgrowths, with well-defined margins and surfaces covered with a grayish secretion. They are among the most distinctive lesions of syphilis.

Frequently the hair falls out (alopecia), either in patches or by a general thinning. Occasionally the nails become affected (syphilitic onychia).

(*d*) *Mucous Lesions.*—With the fever and the roseolous rash the throat and mouth become sore. The pharyngeal mucosa is hyperæmic, the tonsils are swollen and often present small, kidney-shaped ulcers with grayish-white borders. Mucous patches are seen on the inner surfaces of the cheeks and on the tongue and lips. Hypertrophy of the papillæ in various portions of the mucous membrane produces the syphilitic warts or condylomata which are most frequent about the vulva and anus.

(*e*) *Arthritis* and pains in the limbs are common secondary symptoms. Occasionally the joint affection is severe and rheumatic fever is suspected.

(*f*) *Other Lesions.—Iritis* is common, and usually affects one eye before the other. It comes on from three to six months after the chancre. There may be only slight ciliary congestion in mild cases, but in severer forms there is great pain, and the condition is serious and demands careful management. *Choroiditis* and *retinitis* are rare secondary symptoms. Ear affections are not common in the secondary stage, but instances are found in which sudden deafness occurs, which may be due to labyrinthine disease; more commonly the impaired hearing is due to the extension of inflammation from the throat to the middle ear. Epididymitis and parotitis are rare. Jaundice may occur, the *icterus syphiliticus præcox*. The acute nephritis will be referred to later.

Tertiary Stage.—No hard and fast line can be drawn between the lesions of the secondary and those of the tertiary period; and ~~indeed~~, in exceptional cases, manifestations which usually appear late may set in even before the primary sore has properly healed. The special affections of this stage are certain skin eruptions, gummatous growths in the viscera, and amyloid degenerations.

(*a*) The late *syphilides* show a greater tendency to ulceration and destruction of the deeper layers of the skin, so that in healing scars are left. They are also more scattered and seldom symmetrical. One of the most characteristic of the syphilides is *rupia*, the dry stratified crusts of which cover an ulcer which involves the deeper layers of the skin and in healing leaves a scar. It may be a secondary lesion.

(*b*) *Gummata.*—These may occur in the skin, subcutaneous tissue, muscles, or internal organs. The general character has been already described. In the skin they tend to break down and ulcerate, leaving ugly sores which heal with difficulty. In the solid organs they undergo fibroid transformation and produce puckering and deformity. On the mucous membranes these tertiary lesions lead to ulceration, in the healing of which cicatrices are formed; thus, in the larynx great narrowing may result, and in the rectum

ulceration with fibroid thickening and retraction may lead to stricture. Gummatous ulcers may be infective.

(*c*) *Amyloid Degeneration.*—Syphilis plays a most important rôle in the production of this affection. Of 244 instances analyzed by Fagge, 76 had syphilis, and of these 42 had no bone lesions. It follows the acquired form and is very common in association with rectal syphilis in women. In congenital lues amyloid degeneration is rare.

Quaternary Stage.—Long years it may be from the primary sore and from any active manifestations, certain diseases may follow, termed meta- or parasyphilitic affections, the chief of which are locomotor ataxia and dementia paralytica. Since the introduction of the Wassermann reaction these are regarded as definitely syphilitic, dependent upon the parasite itself or in some unknown way upon its poison.

III. CONGENITAL SYPHILIS

With the exception of the primary sore, every feature of the acquired disease may be seen in the congenital form.

The intra-uterine conditions leading to the death of the fetus do not here concern us. The child may be born healthy-looking, or with well-marked evidences of the disease. In the majority of instances the former is the case and within the first month or two the signs of the disease appear.

Symptoms.—(*a*) *At Birth.*—When the disease exists at birth the child is feebly developed and wasted, and a skin eruption is usually present, commonly in the form of bullæ about the hands and feet (pemphigus neonatorum syphiliticus). The child snuffles, the lips are ulcerated, the angles of the mouth fissured, and there is enlargement of the liver and spleen. The bone symptoms may be marked, and the epiphyses may even be separated. In such cases the children rarely survive long.

(*b*) *Early Manifestations.*—When born healthy the child thrives, is fat and plump, and shows no abnormity whatever; then from the fourth to the eighth week, rarely later, a nasal catarrh occurs, *syphilitic rhinitis,* which impedes respiration, and produces the characteristic symptom which has given the name *snuffles* to the disease. The discharge may be sero-purulent or bloody. The child nurses with great difficulty. In severe cases ulceration takes place with necrosis of the bone, leading to a depression at the root of the nose and a deformity characteristic of congenital syphilis. This coryza may be mistaken at first for an ordinary catarrh, but the coexistence of other manifestations usually makes the diagnosis clear. The disease may extend into the Eustachian tube and middle ears and lead to deafness.

The *cutaneous* lesions arise with or shortly after the onset of the snuffles. The skin often has a sallow, earthy hue. The eruptions are first noticed about the nates. There may be an erythema or an eczematous condition, but more commonly there are irregular reddish-brown patches with well-defined edges. A papular syphilide in this region is by no means uncommon. Fissures occur about the lips, either at the angles of the mouth or in the median line. These *rhagades,* as they are called, are very characteristic. There may be marked ulceration of the muco-cutaneous surfaces. The secretions from these mouth lesions are very virulent, and it is from this source that

amino-acid crystals appear in syphilitic & the Osmic acid stain =

finding of spirochaetes in [illegible] tissues

finding of the spirochaetes in the [illegible]

Vedder. Am. J. M.S. Oct. 16

Desquamative dermatitis of palms of hands & soles of feet common.

Epiphysitis common - esp. in children & infants.

Iritis or choroiditis in early pregnancy.

Cardiac murmurs often affected. 47 of [illegible] - 23 defective"

Given a high % of positive Wassermanns in late congenital.

Tr. unsatisfactory in regard to ultimate results

Supernumerary cusps on the mesial side of the upper first two
molars — tubercles of Carabelli.

Suspected Syphilis in any abnormality in a child

Schedule [illegible] case = xxv.

[illegible] a [illegible] first large molar of upper jaw — a
supernumerary cusp on the mesial side of the crown — forms a tubercle of
normally sized cusp (corresponds to [illegible] cusp).

the wet-nurse is usually infected. Not only the nurse, but members of the family, may be contaminated. There are instances in which other children have been accidentally inoculated from a syphilitic infant. The hair of the head or of the eyebrows may fall out. The syphilitic *onychia* is not uncommon. Enlargement of the glands is not so frequent in the congenital as in the acquired disease. When the cutaneous lesions are marked the contiguous glands can usually be felt. As pointed out by Gee, the spleen is enlarged in many cases. The condition may persist for a long time. Enlargement of the liver, though often present, is less significant, since in infants it may be due to various causes. These are among the most constant symptoms of congenital syphilis, and usually arise between the third and twelfth weeks. Frequently they are preceded by a period of restlessness and wakefulness, particularly at night. Some authors have described a peculiar syphilitic cry, high-pitched and harsh. Among rarer manifestations are hæmorrhages—the *syphilis hæmorrhagica neonatorum*. The bleeding may be subcutaneous, from the mucous surfaces, or, when early, from the umbilicus. All of such cases, however, are not syphilitic, and the disease must not be confounded with the acute hæmoglobinuria of new-born infants. E. Fournier has described a remarkable enlargement of the subcutaneous veins.

(*c*) *Late Manifestations.*—Children with congenital syphilis rarely thrive. Usually they present a wizened, wasted appearance, and a prematurely aged face. In the patients who recover the general nutrition may remain good and the child may show no further manifestations of the disease; commonly, however, at the period of second dentition or at puberty the disease reappears. Although the child may have recovered from the early lesions, it does not develop like other children. Growth is slow, development tardy, and there are facial and cranial characteristics which often render the disease recognizable at a glance. A young man of nineteen or twenty may neither look older nor be more developed than a boy of ten or twelve. Fournier describes this condition as *infantilism*. The forehead is prominent, the frontal eminences are marked, and the skull may be very asymmetrical. The bridge of the nose is depressed, the tip *retroussé*. The lips are often prominent, and there are striated lines running from the corners of the mouth. The *teeth* are deformed and may present appearances which Jonathan Hutchinson claims are specific and peculiar. The upper central incisors of the permanent set are peg-shaped, stunted in length and breadth, and narrower at the cutting edge than at the root. On the anterior surface the enamel is well formed, and not eroded or honeycombed. At the cutting edge there is a single notch, usually shallow, sometimes deep, in which the dentine is exposed.

Among late manifestations, particularly apt to appear about puberty, is the interstitial *keratitis*, which usually begins as a slight steaminess of the corneæ, which present a ground-glass appearance. It affects both eyes, though one is attacked before the other. It may persist for months, and usually clears completely, though it may leave opacities, which prevent clear vision. *Iritis* may also occur. Of *ear affections*, apart from those which follow the pharyngeal disease, a form occurs, about the time of puberty or earlier, in which deafness comes on rapidly and persists in spite of all treatment. It is unassociated with obvious lesions, and is probably labyrinthine in character. *Bone lesions*, occurring oftenest after the sixth year, are not rare among the late

manifestations of hereditary syphilis. The tibiæ are most frequently attacked. It is really a chronic gummatous periostitis, which gradually leads to great thickening of the bone. The nodes of congenital syphilis, which are often mistaken for rickets, are more commonly diffuse and affect the bones of the upper and lower extremities. They are generally symmetrical and rarely painful. They may occur late, even after the twenty-first year.

Joint lesions are rare. Clutton has described a symmetrical synovitis of the knee in hereditary syphilis. Enlargement of the spleen, sometimes with the lymph-glands, may be one of the late manifestations, and may occur either alone or in connection with disease of the liver.

Gummata of the liver, brain, and kidneys have been found in late hereditary syphilis. General paresis may follow.

Is syphilis transmitted to the third generation? Opinion on this subject is divided. Occasionally cases of pronounced congenital syphilis are met with in the children of parents who are perfectly healthy, and who have not, so far as is known, had syphilis; and yet, as remarked by Coutts in reporting such a group of cases, they do not always bear careful scrutiny. E. Fournier, in his *L'Hérédo-Syphilis Tardive* (1907), cites interesting examples which appear to prove the transmission to the third generation, and this appears to be the view of the French syphilographers. Sir Jonathan Hutchinson ~~is still~~ opposed to this view.

IV. VISCERAL SYPHILIS

1. *Syphilis of the Brain and Cord*

Pathology.—There are three anatomical changes in the central nervous system—new growths, arteritis, and chronic degenerative (sclerotic) processes.

(*a*) The new formations or *gummata* form definite tumors, ranging in size from a pea to a walnut, usually multiple and attached to the pia mater, sometimes to the dura. Very rarely they are found unassociated with the meninges. When small they present a uniform, translucent appearance, but when large the centre undergoes a fibro-caseous change, while at the periphery there is a firm, translucent, grayish tissue. They may resemble large tuberculous tumors. The growths are most common in the cerebrum. They may be multiple and may even attain a considerable size without becoming caseous. Occasionally gummata undergo cystic degeneration. In the cord large growths are not so common.

In the neighborhood of the growths gummous meningitis occurs, in which all the membranes are involved. This is more common at the base, about the chiasma and the interpeduncular space, and along the Sylvian fissures.

(*b*) *Arteritis* occurs in the form of nodular tumors on the vessels, which may break down or lead to rupture, or there is a progressive obliterative endarteritis.

(*c*) *Degenerative fibroid changes,* not distinctive anatomically, but clinically directly connected with the disease, are known as post- or meta-syphilitic.

Secondary Changes.—In the brain gummatous arteritis is one of the common causes of softening, which may be extensive, as when the middle cerebral

Cerebrosp. syph. – Byrnes. J.A.M.A. 1914. 63. 2182

1. Syphilitic meningitis – see text.
2. Cerebrosp. syphilis in which the nervous tissue is directly affected – as meningomyelitis, gumma, tabes v. q. v.
3. Cerebr. sp. syph. – arteritis –

If vascular lesions only: no special fluid will probably be noted.

–

Mercurialized serum (91 1/50 of Brichelmidt)

–

In disease of meninges & vessels, treat. better chance if no nervous tissue – yields muchbetter

–

Secondary degeneration may occur & even when this is not amenable to specific treatment

abolition of ocular & cardiac reflexes

In syphilis of nerv. syst. meninges & vessels involved. Interferes & paresis the nerve-cells.

Prot. 25% shows some changes in CF sterile.

Lee re nivalis. ni [illegible] stage – Wilcox Stokes. J. Am. Med. Ass. 20, 05: h. 975

changes in spinal fluid
[illegible] 70 to 80%. – ni [illegible] stage

JAMA. May 20. 16. blood
Frequency [illegible]. Matuschek, Wilcz. 4134 Austrian officers
infected bet. 1880 & 1890. Studied Leipz. 4.67% had tabes & paresis 1.5%
had tabes. total 6.27%. Muerbotte.

(Hess – Bacot. – [illegible]

lymphocytosis – ni 85-90%. often over 100
carb. blue.
may reach 1000.

Often [illegible] – Wassermann – 85-90%
also
globulin.
blood Wassermann – 70-80%.
globulin fluid – 90-95%.

Colloidal gold
75-80%

artery is involved, or when there is a large patch of meningitis. In such instances the process is really a meningo-encephalitis, and the symptoms are due to the secondary changes, not directly to the gumma. In the neighborhood of the gumma intense encephalitis or myelitis may occur, and within a few days change the clinical picture.

Syphilitic disease of the nerve-centres occurs usually in the acquired form. In the congenital cases the tumors usually occur early, but may be as late as the twenty-first year. Of late years it has been recognized that the nervous lesions may occur very early in the disease, even before the induration of the primary sore has gone. In a majority of the cases brain symptoms come on within three or four years after infection.

Symptoms.—The chief features of cerebral syphilis are those of tumor cerebri, which will be considered later. They may be classified here as follows:

(*a*) Psychical features. A sudden and violent onset of delirium may be the first symptom. In other instances prior to the occurrence of delirium there have been headache, alteration of character, and loss of memory. The condition may be accompanied by convulsions. There may be no neuritis, no palsy, and no localizing symptoms.

(*b*) More commonly following headache, giddiness, or an excited state which may amount to delirium, the patient has an epileptic seizure or a hemiplegic attack, or there is involvement of the nerves of the base. Some of these cases display a prolonged torpor, a special feature of brain syphilis to which both Buzzard and Huebner have referred, which may persist for as long as a month.

(*c*) In some cases the clinical picture is that of general paralysis—dementia paralytica.

(*d*) Many cases of cerebral syphilis display the symptoms of brain tumor—headache, optic neuritis, vomiting, and convulsions. Of these symptoms convulsions are the most important, and both Fournier and Wood have laid great stress on the value of this symptom in persons over thirty. The first symptoms may, however, rather resemble those of embolism or thrombosis; thus there may be sudden hemiplegia, with or without loss of consciousness.

The symptoms of *spinal syphilis* are extremely varied and may be caused by large gummatous growths attached to the meninges, in which case the features are those of tumor, by gummatous arteritis with secondary softening, by meningitis with secondary cord changes, or by scleroses occurring late in the disease. Syphilitic myelitis will be considered under affections of the spinal cord.

Diagnosis.—The history is of the first importance, but it may be extremely difficult to get a trustworthy account. Careful examination should be made for traces of the primary sore, for the cicatrices of bubo, for scars of the skin eruption or throat ulcers, and for bone lesions. The character of the symptoms is often of great assistance. They are multiform, variable, and often such as could not be explained by a single lesion; thus there may be anomalous spinal symptoms or involvement of the nerves of the brain on both sides. The Wassermann reaction is of the greatest aid, and lastly the result of treatment has a definite bearing on the diagnosis, as the symptoms may clear up and disappear with the use of antisyphilitic remedies.

2. *Syphilis of the Respiratory Organs*

Syphilis of the Trachea and Bronchi.—L. A. Conner has analyzed 128 recorded cases of syphilis of the trachea and bronchi. In 52 per cent. of the cases the trachea was alone involved. In only 10 per cent. were characteristic lesions of syphilis found in the lungs. Bronchial dilatation below the lesion was found in 15 per cent. of the cases. In ten of the cases the lesion occurred in congenital syphilis.

Syphilis of the Lung.—This is a very rare disease. In 2,800 post mortems at the Johns Hopkins Hospital there were 12 cases with syphilitic disease in the lungs; in 8 of these the lesions were in congenital syphilis. In 11 cases there were definite gummata. Clinically the presence of syphilis of the lung was suspected in three cases. Some years ago Fowler visited the museums of the London hospitals and the Royal College of Surgeons, and could find only twelve specimens illustrating syphilitic lesions of the lungs, two of which are doubtful. For the most full and satisfactory consideration of pulmonary syphilis, the reader is referred to chapter xxxvii of Fowler and Godlee's work on Diseases of the Lungs.

It occurs under the following forms:

(*a*) *The white pneumonia of the fetus.* This may affect large areas or an entire lung, which then is firm, heavy, and airless, even though the child may have been alive. On section it has a grayish-white appearance—the so-called white hepatization of Virchow. The chief change is in the alveolar walls, which are greatly thickened and infiltrated, and the section is like one of the pancreas—"pancreatization" of the lung. In the early stages, for example, in a seven or eight months' fetus, there may be scattered miliary foci of this induration chiefly about the arteries. The air-cells are filled with desquamated and swollen epithelium.

(*b*) In the form of definite *gummata,* which vary in size from a pea to a goose-egg. They occur irregularly scattered through the lung, but, as a rule, are more numerous toward the root. They present a grayish-yellow caseous appearance, are dry and usually imbedded in a translucent, more or less firm, connective tissue. In a case from my wards described by Councilman there was extensive involvement of the root of the lungs. Bands of connective tissue passed inward from the thickened pleura, and between these strands and surrounding the gummata there was in places a mottled red pneumonic consolidation. In the caseous nodules there is typical hyaline degeneration. In a few rare instances there are most extensive caseous gummata with softening and formation of bronchiectatic cavities, and clinically a picture of pulmonary tuberculosis without the presence of tubercle bacilli. In one case, a man aged twenty-seven, admitted in April, 1902, had had for a year cough and bloody expectoration and died of severe hæmoptysis. Bacilli were never found in the sputum. There were extensive caseous gummata throughout both lungs, with much fibrous thickening, and in the lower lobe of the right lung a cavity 3 by 5 cm. in diameter, on the wall of which a branch of the pulmonary artery was eroded. This is the only instance among my cases in which there was an extensive destruction of the lung tissue with the clinical picture simulating pulmonary phthisis.

(*c*) A majority of authors follow Virchow in recognizing the fibrous in-

Forms.

1. White pneumonia

2. Areas of consolidation. apical.

January 1875.

Landis thesis. Amer Jour. 1915. 150. 155.

form acute tub. empty bl Streptococcus Sh. Staphylococcus

signs of early tubercular disorder with Salmonella

Bronchiectasis in children. suspect syphilis.

terstitial pneumonia at the root of the lung and passing along the bronchi and vessels as probably syphilitic. This much may be said, that in certain cases gummata are associated with these fibroid changes. Again, this condition alone is found in persons with well-marked syphilitic history or with other visceral lesions. It seems in many instances to be a purely sclerotic process, advancing sometimes from the pleura, more commonly from the root of the lung, and invading the interlobular tissue, gradually producing a more or less extensive fibroid change. It rarely involves more than a portion of a lobe or portions of the lobes at the root of the lung. The bronchi are often dilated.

Diagnosis.—It is to be borne in mind, in the first place, that hospital physicians and pathologists the world over bear witness to the extreme rarity of lung syphilis. In the second place, the therapeutic test upon which so much reliance is placed is by no means conclusive. With pulmonary tuberculosis there should be no confusion, owing to the readiness with which the presence of bacilli is determined. Bronchiectasis in the lower lobe of a lung, dependent upon an interstitial pneumonia of syphilitic origin, could not be distinguished from any other form of the disease. In persons with well-marked syphilitic lesions elsewhere, when obscure pneumonia with dilated bronchi and no tubercle bacilli are present, the condition may possibly be due to syphilis. So far as my experience goes, tuberculous phthisis occurring in a syphilitic subject has no special peculiarities. The lesions of syphilis and tuberculosis could may of course coexist in a lung. The Wassermann reaction is helpful in a doubtful case.

3. *Syphilis of the Liver*

Varieties.—Inherited.—(*a*) *Congenital.*—Gubler in 1852 first described the diffuse hepatitis which occurs in a large percentage of all deaths in congenital lues. While there may be little or no macroscopic change, the liver preserves its form and is usually enlarged, hard and resistant, and has a yellowish color, compared by Trousseau to sole-leather, or by Gubler to that of flint. Small grayish nodules may be seen on the section. In other cases there are definite gummata with extensive sclerosis. The spirochætes are present in extraordinary numbers.

The child may be still-born or die shortly after birth, or it may be healthy when born and the liver enlarges within a few weeks. The organ is firm; the edge may be readily felt, usually far below the navel. The spleen is also enlarged. The general features are those of a hypertrophic cirrhosis, but jaundice and ascites are not common. Hochsinger states that of 45 cases recovery took place in 30.

(*b*) *Delayed Congenital Syphilis.*—The condition is by no means rare. Of 132 cases of syphilis hereditaria tarda collected by Forbes, in 34 the liver was involved. The children are nearly always ill-developed, sometimes with marked clubbing of the fingers and showing signs of infantilism. Jaundice is rare. The liver is usually enlarged, or it may show nodular masses.

Acquired Syphilis.—(*a*) In the *secondary stages* of the disease the liver is not often involved. Jaundice may occur coincident with the rash and with the enlargement of the superficial glands. Rolleston thinks it is probably due to a catarrhal condition of the smaller ducts, part of a general syphilitic hepatitis. There are cases in which it has passed on to a state of

acute yellow atrophy. The liver is slightly enlarged. The prognosis is generally good.

(*b*) *Tertiary Lesions.*—The frequency with which the liver is involved in syphilis in adults is very variously estimated. J. L. Allen, quoted by Rolleston, found 37 cases of hepatic gummata among 11,629 autopsies at St. George's Hospital; in 27 cases cicatrices alone were present. Flexner at the Philadelphia Hospital found 88 cases of hepatic syphilis among 5,088 autopsies. Among 2,300 autopsies at the Johns Hopkins Hospital (Professor Welch) there have been 47 cases of syphilis of the liver, gummata in 19, scars in 16, cirrhosis in 21 cases; 6 of the cases were congenital. My experience coincides with that of Einhorn and of Stockton, who hold that in the United States the disease is by no means uncommon. In 21 cases the diagnosis of syphilis of the liver was made clinically.

Anatomically the lesions may be either gummata or scars or a syphilitic sclerosis. The gummata range in size from a pea to an orange. When small they are pale and gray; the larger ones present yellowish centres; but later there is a "pale, yellowish, cheese-like nodule of irregular outline, surrounded by a fibrous zone, the outer edge of which loses itself in the lobular tissue, the lobules dwindling gradually in its grasp. This fibrous zone is never very broad; the cheesy centre varies in consistence from a gristle-like toughness to a pulpy softness; it is sometimes mortar-like, from cretaceous change" (Wilks). They may form enormous tumors, as in the remarkable one figured ~~on page 351~~ in Rolleston's work on Diseases of the Liver. They may be felt as large as an orange beneath the skin in the epigastrium and they may disappear with the same extraordinary rapidity as the subcutaneous or periosteal gumma. Macroscopically they may, indeed, at first look like massive cancer. Extensive caseation, softening and calcification may occur. The syphilitic scars are usually linear or star-shaped. They may be very numerous and divide the liver into small sections—the so-called botyroid organ, of which a remarkable example is figured in my *Lectures on Abdominal Tumors.* The syphilitic cirrhosis is usually combined with gummata, or with marked scarring in the portal canal, leading to lobulation of the organ, but the ordinary multilobular cirrhosis is not common.

Symptoms.—In the first place, the clinical picture may be that of cirrhosis—slight jaundice, fever, portal obstruction, ascites. There may not be the slightest suspicion of the syphilitic nature of the case. One of my patients had been tapped thirteen times before admission to the hospital. The diagnosis was made by finding gummata on the shins. She recovered promptly.

In a second group of cases the patient is anæmic, passes large quantities of pale urine containing albumin and tube-casts; the liver is enlarged, perhaps irregular, and the spleen also is enlarged. Dropsical symptoms may supervene, or the patient may be carried off by some intercurrent disease. Extensive amyloid degeneration of the spleen, the intestinal mucosa, and of the liver, with gummata, is found.

Thirdly, in a very important group the symptoms are those of tumor of the liver, causing pain and distress, and on examination an irregular mass is discovered. The tumor may be large, causing a prominent bulging in the epigastrium. Naturally carcinoma is thought of, as there may be nothing to suggest syphilis. In other cases the history or the presence of gummata else-

Smithies J.A.M.A. 1965 - 65. 577. (Aug 14)

26 cases - no clinical heart signs.
Dyspnoea. x-ray. not pathognomonic.

⇒ Bumpy rugae - obliteration of the usual surface markings -
smoothness and induration of the tissues. Normally bases of
tongue presents small rounded elevations like lymphoid follicles.
Thus hypertrophies in II Stage. Later discrete are replaced by fibrous
tissue - base of tongue becomes pebble-like & indurated.
Dysarthria & death.

may occur in secondary stage - but usually late
fatty degeneration of myocardium even when are coronary disease
fibroid changes in aorta - papillary muscles may be affected -
epicardial changes common - with pericarditis -
5 common causes coronary disease = especially in females
Syncope, soft apex systolic murmur - often not transmitted. in Sec. Stage.
accompanied by exercise often very pain with it
rhythm disturbed. + tachycardia

Later - dyspnoea & less often cyanosis.
precordial tenderness. (angina pain.)
disturb. of rhythm = gen. features any muscle disease.

Ther. Treat. espec. mercury.

where should aid in the diagnosis. In other instances the rapid disappearance under treatment even of a large visible tumor makes the syphilitic nature quite positive. Lastly, in a few cases the irregular fever with enlargement and irregularity of the liver may suggest suppuration, or the uniform great enlargement of the organ hypertrophic biliary cirrhosis, while there are some cases in which the spleen is so greatly enlarged, the anæmia so pronounced, and the liver so small and contracted that the diagnosis of splenic anæmia is made.

4. *Syphilis of the Digestive Tract*

The *œsophagus* is very rarely affected. Stenosis is the usual result. Syphilis of the *stomach* is excessively rare. Flexner reported a remarkable case in association with gummata of the liver, and collected 14 cases in the literature. Syphilitic ulceration has been found in the small intestine and in the cæcum.

The most common seat in this tract is the *rectum*. The affection is found most commonly in women, and results from the growth of gummata in the submucosa above the internal sphincter. The process is slow and tedious, and may last for years before it finally induces stricture. The symptoms are usually those of narrowing of the lower bowel. The condition is readily recognized by rectal examination. The history of gradual on-coming stricture, the state of the patient, and the fact that there is a hard, fibrous narrowing, not an elevated crater-like ulcer, usually render easy the diagnosis from malignant disease. In medical practice these cases come under observation for other symptoms, particularly amyloid degeneration; and the rectal disease may be entirely overlooked, and only discovered post mortem.

5. *Circulatory System*

Syphilis of the Heart.—A fresh, warty endocarditis due to syphilis is not recognized, though occasionally in persons dead of the disease this form is present, as is not uncommon in conditions of debility. Outgrowths on the valves in connection with gummata have been reported by Janeway and others. Loomis groups the lesions into: (1) Gummata, recent or old; (2) fibroid induration, localized or diffuse; (3) amyloid degeneration; and (4) endarteritis obliterans. Changes in the blood-vessels of the walls of the heart are common both in congenital and acquired syphilis, even in cases without clinical symptoms or gross lesions (Adler).

Rupture may take place, as in the cases reported by Dandridge and Nalty, or sudden death, as in the cases of Cayley and Pearce Gould; indeed, sudden death is frequent, occurring in 21 of 63 cases (Mracek).

Syphilis of the Arteries.—Syphilis plays an important rôle in arteriosclerosis and aneurism. Its connection with these processes will be considered later; here we shall refer only to the syphilitic affection of the smaller vessels, which occurs in two forms:

(*a*) An *obliterating endarteritis*, characterized by a proliferation of the subendothelial tissue. The new growth lies within the elastic lamina, and may gradually fill the entire lumen; hence the term obliterating. The ... and adventitia are also infiltrated with small cells. This form of endarteritis

described by Huebner is not, however, characteristic of syphilis, and its presence alone in an artery could not be considered pathognomonic. If, however, there are gummata in other parts, or if the condition about to be described exists in adjacent arteries, the process may be regarded as syphilitic.

(*b*) *Gummatous Periarteritis.*—With or without involvement of the intima, nodular gummata may develop in the adventitia of the artery, producing globular or ovoid swellings, which may attain considerable size. They are not infrequently seen in the cerebral arteries, which seem to be specially prone to this affection. This form is specific and distinctive of syphilis. Many observers have found *Treponema pallidum* in the syphilitic aortitis, and also in gummatous arteritis of the cerebral vessels.

6. *Renal Syphilis*

Gummata.—Gummata occasionally are found in the kidneys, particularly in cases in which there is extensive gummatous hepatitis. They are rarely numerous, and occasionally lead to scattered cicatrices. Clinically the affection is not recognizable.

Acute Syphilitic Nephritis.—This condition has been carefully studied by the French writers and by Lafleur of Montreal. It is estimated to occur in the secondary stage in about 3.8 per cent., and may occur in from three to six months, sometimes later, from the initial lesion. The outlook is good, though often the albuminuria may persist for months; more rarely chronic nephritis follows. In a few instances syphilitic nephritis has proved rapidly fatal in a fortnight or three weeks. The lesions are not specific, but are similar to those in other acute infections.

7. *Syphilitic Orchitis*

This affection is of special significance to the physician, as its detection frequently clinches the diagnosis in obscure internal disorders. Syphilis occurs in the testes in two forms:

(*a*) The gummatous growth, forming an indurated mass or group of masses in the substance of the organ, and sometimes difficult to distinguish from tuberculous disease. The area of induration is harder and it affects the body of the testes, while tubercle more commonly involves the epididymis. It rarely tends to invade the skin, or to break down, soften, and suppurate, and is usually painless.

(*b*) There is an *interstitial orchitis* regarded as syphilitic, which leads to fibroid induration of the gland and gradually to atrophy. It is a slow, progressive change, coming on without pain, usually involving one organ more than another.

V. DIAGNOSIS, TREATMENT, ETC.

Diagnosis.—General Diagnosis of Syphilis.—There is seldom any doubt concerning the recognition of syphilitic lesions; but the number of persons, without any evident sign of the disease, in whom a positive Wassermann reaction is found proves that a negative diagnosis cannot be based on the absence of history and clinical manifestations. Syphilis is common in the

Ann. Surgery. med. Jour. Nov 1913. vii. 15

weight. Summary of tests [illegible]

Syphilis is [illegible] without any chancre or accessory lesions. Many mild. Both these cases taken as followed by Pubes, Dance [illegible] age"

Lectio – given in non-syphilitic by
V.I given before
Shamick. JAMA 1915 Es 4x4

community, and is no respecter of age, sex, or station in life. It is possible that the primary sore may have been of trifling extent, or urethral and masked by a gonorrhœa, and the patient may not have had severe secondary symptoms, but such instances are extremely rare. Inquiries should be made into the history to ascertain if the patient has had skin rashes, sore throat, or if the hair has fallen out. Careful inspection should be made of the throat and skin for signs of old lesions. Scars in the groins, the result of buboes, are uncertain evidences of syphilitic infection. The cicatrices on the legs are often copper-colored, though this cannot be regarded as peculiar to syphilis. The bones should be examined for nodes. In doubtful cases the scar of the primary sore may be found, or there may be signs of atrophy or of hardening of the testes. In women special stress has been laid upon the occurrence of frequent miscarriages, which, in connection with other circumstances, are always suggestive.

In the congenital disease, the occurrence within the first three months of snuffles and skin rash is conclusive. Later, the characters of the syphilitic facies, already referred to, often give a clew to the nature of some obscure visceral lesion. Other distinctive features are the symmetrical development of nodes on the bones and the interstitial keratitis.

The *Treponema pallidum* may be studied from the fresh lesion. After cleaning carefully, serum is sucked out with a small Bier apparatus, and the living spirochætes may be seen in the special "dark field" apparatus, ~~used for the purpose~~.

Serum Diagnosis.—The Wassermann reaction in good hands may be accepted as a most valuable aid in diagnosis. It is obtained in from 80 to 90 per cent. of all cases of syphilis with manifestations. The results in tabes and dementia paralytica are very constant.

Cutaneous Reaction.—An emulsion or extract of pure cultures of *Treponema pallidum*—termed *luetin*—has been employed by Noguchi to obtain a skin reaction. The skin is sterilized and 0.05 c. c. injected intradermically. The local reaction is usually papular, and surrounded by a zone of redness, but may become pustular. There is very slight constitutional effect. The reaction is most constant and marked in tertiary and hereditary cases; it is infrequent, and, if present, mild in the primary and secondary stages, in which the Wassermann reaction is more constant. Treatment affects the Wassermann more than the cutaneous reaction.

Therapeutic Test.—In a doubtful case, as, for example, an obstinate skin rash or an obscure tumor in the abdomen, antisyphilitic treatment may prove successful, but this cannot always be relied upon.

Prophylaxis.—Irregular intercourse has existed from the beginning of recorded history, and unless man's nature wholly changes—and of this we can have no hope—will continue. Resisting all attempts at solution, the social evil remains the great blot upon our civilization, and inextricably blended with it is the question of the prevention of syphilis. Two measures are available—the one personal, the other administrative.

Personal purity is the prophylaxis which we, as physicians, are especially bound to advocate. Continence may be a hard condition (to some harder than to others), but it can be borne, and it is our duty to urge this lesson upon young and old who seek our advice in matters sexual. Certainly it is better,

as St. Paul says, to marry than to burn, but if the former is not feasible there are other altars than those of Venus upon which a young man may light fires. He may practice at least two of the five means by which, as the physician Rondibilis counseled Panurge, carnal concupiscence may be cooled and quelled—hard work of body and hard work of mind. Idleness is the mother of lechery; and a young man will find that absorption in any pursuit will do much to cool passions which, though natural and proper, cannot in the exigencies of our civilization always obtain natural and proper gratification.

To carry out successfully any administrative measures seems hopeless, at any rate in our Anglo-Saxon civilization. The state accepts the responsibility of guarding citizens against small-pox or cholera, but in dealing with syphilis the problem has been too complex and has hitherto baffled solution. Inspection, segregation, and regulation are difficult, if not impossible, to carry out, and public sentiment is bitterly opposed to this plan. The compulsory registration of every case of gonorrhœa and syphilis, with greatly increased facilities for thorough treatment, offers a more acceptable alternative.

The patient should be warned of the various ways in which he may spread the disease and given directions regarding this. Measures for the prevention of infection after exposure can be carried out in the military and naval services more readily than in civil life. The most successful is the application of mercurial ointment mixed with lanolin soon after exposure.

Treatment.—That the later stages which come under the charge of the physician are so common results, in great part, from the carelessness of the patient, who, wearied with treatment, cannot understand why he should continue to take medicine after all the symptoms have disappeared; but, in part, the profession also is to blame for not insisting more urgently that acquired syphilis is not cured in a few months, but takes at least three years, during which time the patient should be under careful supervision.

The patient should lead a regular life, avoiding excess of all kinds. If there is fever rest in bed is advisable. The usual diet can be taken and the patient should drink large quantities of water. The use of alcohol and tobacco should be forbidden during active treatment. When mercury is being taken special care must be given to the mouth. A mouth wash and a potassium chlorate tooth paste should be used frequently. Treatment consists essentially in the use of three remedies, mercury, arsenic and iodide of potassium.

Mercury.—It is usually well to push the administration of mercury so that the patient is brought under its influence as rapidly as possible, but salivation is to be avoided. Mercury may be given by the *mouth* in the form of gray powder, the hydrargyrum cum cretâ, which Hutchinson recommends to be given in pills, one-grain doses with a grain of Dover's powder. One pill from four to six times a day will usually suffice. I warmly endorse the excellent results which are obtained by this method, under which the patient often gains rapidly in weight, and the general health improves remarkably. It may be continued for months without any ill effects. Other forms given by the mouth are biniodide (gr. 1/16), the protoiodide (gr. 1/4), or the bichloride (gr. 1/16 to 1/8), three times a day.

Inunction is a still more effective means. A drachm of the ordinary mercurial ointment or the oleate of mercury is thoroughly rubbed into the skin,

on areas free from hair, every evening for six days; on the seventh a warm bath is taken, and on the eighth the mercurial course is resumed. At least half an hour should be given to each inunction. It is well to apply it to different places on successive days. The sides of the chest and abdomen and the inner surfaces of the arms and thighs are the best positions. A course of thirty to forty inunctions should be given.

The mercury may be given by intramuscular *injection*. If proper precautions are taken in sterilizing the syringe, and if the injections are made into the muscles, not into the subcutaneous tissue, abscesses rarely result. Mercury salicylate as a 10 per cent. solution in albolene, of which ten minims are given every five to seven days, bichloride of mercury (gr. 1/20 to 1/10) in olive oil, the "gray oil," or calomel (gr. i) in equal parts of glycerine and water (1 of calomel to 10 of the mixture) are the usual preparations. A course of twenty to thirty injections should be given.

Intravenous injections are sometimes given in malignant cases. Fifteen minims of a .1 to .2 solution of the bichloride in sterile salt solution are administered.

Still another method in vogue in certain parts of the Continent and in institutions is *fumigation*. The patient sits on a chair wrapped in blankets, with the head exposed. Calomel (gr. xx, 1.3 gm.) is volatilized and deposited with the vapor on the patient's skin. The process lasts about twenty minutes, and the patient goes to bed wrapped in blankets without washing or drying the skin.

ARSENIC.—While atoxyl and cacodylate of sodium have been employed, the safest and most useful preparation is Ehrlich's SALVARSAN (dioxydiamido-arsenobenzol). We are not yet able to speak with finality regarding all the points with reference to its use, but it is certainly a valuable addition to our treatment of syphilis. It should be given *intravenously* and only by those who are properly instructed in the method. The salt solution employed should be prepared from water *freshly* distilled not more than a few hours before from glass and not from metal. The solution is prepared as follows: To 30 c. c. of sterile freshly distilled water in a graduated sterile glass vessel the amount of salvarsan to be given is added and dissolved by vigorous shaking which may be aided by glass beads. When complete solution has occurred a 15 per cent. solution of sodium hydroxide solution is added drop by drop. This causes a precipitate to form and sufficient sodium hydroxide is then added drop by drop until this dissolves. Sterile salt solution (0.5 per cent.) is then added to bring the quantity up to 200 c. c. Salvarsan should be given well diluted (40 c. c. of solution to 0.1 gm. of salvarsan), and always in a freshly prepared solution. The solution is best injected into one of the veins at the elbow and may be given by a syringe with a three-way cock or by gravity through a funnel or from a glass cylinder. Some salt solution should be run in first to be sure that the needle is in the vein and the salvarsan solution then given. Salt solution should be given at the end. It is wise for the patient to remain in bed for two days after the injection.

The most suitable dosage is not yet determined. Some give two doses (0.5 gm., 7½ grains) at intervals of ten days, others one dose (0.5 gm.) followed by several smaller ones (0.2 gm., 3 grains), others repeated small doses (0.2 gm.) at intervals; half a gram may be regarded as an average

maximum dose, but larger amounts are sometimes given. For young children doses of 0.1 to 0.2 gm. are used and for infants 0.02 to 0.1 gm. In determining the amount to be given, the weight of the patient is a good indication. Changes in the eye grounds and severe circulatory and renal lesions are regarded as contra-indications to the use of salvarsan. Caution is advisable in the syphilitic lesions of the aorta and aortic valves; if salvarsan is used, small doses (0.2 gm.) should be given.

The conditions in which salvarsan is especially useful are: (1) at the onset when the diagnosis is made early; one dose (0.5 gm.) may be sufficient. (2) In patients with severe skin or mucous membrane lesions. (3) In intractable cases, in those resistant to or unable to take mercury. (4) In malignant cases. (5) In congenital syphilis. (6) In latent cases, in which without any signs of syphilis a Wasserman reaction is present. In visceral syphilis the drug is less useful. Its value in lesions of the nervous system is not settled; some patients are undoubtedly benefited and the same may be said of the para-syphilitic affections. In general the earlier in the course the drug is given the better the effect.

Mercury should always be given after salvarsan, which, except perhaps in a few cases given at the onset, can not be regarded as a complete remedy in itself. If the patient is seen early salvarsan should be given and followed by mercury, the first course of which should be by inunction or injection if possible, and after this by mouth. The mixed treatment should only be given after a thorough course of mercury. For one year mercury should be given as continuously as possible; during the second year intermissions are advisable, but not for more than one-quarter of the time.

In CONGENITAL SYPHILIS the treatment of cases born with bullæ and other signs of the disease is not satisfactory, and the infants usually die within a few days or weeks. The child should be nursed by the mother alone, or, if this is not feasible, should be hand-fed, but under no circumstances should a wet-nurse be employed. The child is most rapidly and thoroughly brought under the influence of the drug by inunction. The mercurial ointment may be smeared on the flannel roller. This is not a very cleanly method, and sometimes rouses the suspicion of the mother. It is preferable to give the drug by the mouth, in the form of gray powder, half a grain three times a day. In the late manifestations associated with bone lesions the combination of mercury and iodide of potassium is most suitable and is well given in the form of Gilbert's syrup, which consists of the biniodide of mercury (gr. j), of potassium iodide (℥ss.), and water (℥ij). Of this the dose for a child under three is from five to ten drops three times a day, gradually increased. Under these measures the cases of congenital syphilis usually improve with great rapidity. The medication should be continued at intervals for many months, and it is well to watch these patients carefully during the period of second dentition and at puberty, and if necessary to place them on specific treatment.

In the treatment of the VISCERAL LESIONS of syphilis, which come more distinctly within the province of the physician, iodide of potassium is of equal or even greater value than mercury. Under its use ulcers rapidly heal, gummatous tumors melt away, and we have an illustration of a specific action only equaled by that of mercury in the secondary stages, by iron in certain

del [illegible]

or ceruara

effecting [illegible] - unauthenticated fatty acid radicals which might
autolysis unsaturated by oxidation - permanent marine cheese
autolysis occurs, meroki seizure absorbed (Jobling & Petersen)

Wassermann test.

Yaws. Spirochaeta pertenuis (v. pallidula) – Cana

forms of anæmia, and by quinine in malaria. It is as a rule well borne in an initial dose of 10 grains (0.6 gm.); given in milk the patient does not notice the taste. It should be gradually increased to 30 or more grains three times a day. In syphilis of the nervous system it may be used in still larger doses.

When syphilitic hepatitis is suspected the combination of mercury and iodide of potassium is most satisfactory. If there is ascites, Addison's or Guy's pill (as it is often called) of calomel, digitalis, and squill will be found very useful. Occasionally the iodide of sodium is more satisfactory than the iodide of potassium. It is less depressing and agrees better with the stomach.

Syphilis and Marriage.—Upon this question the family physician is often called to decide. He should insist upon the necessity of two full years elapsing between the date of infection and the contracting of marriage. This, it should be borne in mind, is the earliest possible limit, and marriage should be allowed only if the treatment has been thorough and if at least a year has passed without any manifestation of the disease.

Syphilis and Life Insurance.—An individual with syphilis can not be regarded as a first-class risk unless he can furnish evidence of prolonged and thorough treatment and of immunity for two or three years from all manifestations. Even then, when we consider the extraordinary frequency of the cerebral and other complications in persons who have had this disease and who may even have undergone thorough treatment, the risk to the company is certainly increased (see Bramwell, Clinical Studies, vol. i).

VIII. DISEASES DUE TO PARASITIC INFUSORIA

Several flagellates are parasitic in man. The *Trichomonas vaginalis,* which measures 15 μ to 25 μ in length and has four flagella, ~~which are~~ as long as or longer than the body, is by no means uncommon in the acid vaginal mucus.

The *Trichomonas* or *Cercomonas hominis* lives in the intestines, and is met with in the stools under all sorts of conditions. Freund from Dock's clinic ~~has~~ reported a series of cases which show that the parasite may cause acute and chronic diarrhœa with severe abdominal pain, and anatomically an acute enteritis. In one of Dock's cases the parasites were associated with a hæmorrhagic cystitis without bacteria.

The *Lamblia intestinalis* is another intestinal monad, larger than the common trichomonas. Flagellates have also been found in the expectoration in cases of gangrene of the lung and of bronchiectasis, and in the exudate of pleurisy.

The *Balantidium coli,* oval in form, 70 μ to 100 μ long and 50 μ to 70 μ broad, may be pathogenic. It is common in pigs, and has been known to produce an epidemic dysentery in apes (Harlow Brooks). The pathological significance of this parasite has been demonstrated by Strong and Musgrave in the Philippines, where it is a cause of dysentery. It has not only been found in the stools and on the mucous membrane of the intestine, but the parasites have occurred in the mucosa itself and in the submucosa. Apparently they do not extend beyond the wall of the bowel.

D. DISEASES DUE TO METAZOAN PARASITES

I. DISEASES DUE TO FLUKES—DISTOMIASIS

The Trematoda or flukes are parasitic platyhelminths, usually with flattened or leaf-shaped bodies. The term *Distomiasis* is based upon Distoma, the term being used to designate the trematodes.

The following are the important clinical forms:

1. Pulmonary Distomiasis; Parasitic Hæmoptysis.—*Paragonimus* (Distoma) *westermanii*, the Asiatic lung or bronchial fluke, is from 8 to 16 mm. in length by 4 to 8 mm. broad, and of a pinkish or reddish-brown color.

It is found extensively in China and Japan, Formosa, and the Philippines, and cases are occasionally imported into Europe and America, and has been ~~met with~~ found in the oriental population of the Pacific coast. It has been found in the United States in the cat, in the dog, and in the hog. One instance of pulmonary distomiasis has been reported caused by the giant liver fluke.

Clinically the disease, as described by Manson and Ringer, is characterized by a chronic cough, with rusty-brown sputum, and occasional attacks of hæmoptysis, usually trifling, but sometimes very severe. The disease is very apt to be mistaken for tuberculosis, but the diagnosis is easily made by microscopic examination of the sputum. The ova, which are abundant in the sputum, are oval, smooth, and measure from 80 μ to 100 μ in length by 40 μ to 60 μ in breadth. The parasites may affect other organs—the liver, the brain, and eyelid.

2. Hepatic Distomiasis.—Six species of liver flukes are known to occur in man. More specifically these are: (1) The common liver fluke—*Fasciola hepatica*—which is a very common parasite in the ruminants. It is a rare and accidental parasite in man, but in Syria a strange disease called *Halzoun* is caused by eating raw goat-liver infected with the parasite. (2) The lancet fluke—*Dicrocœlium* (*Distoma*) *lanceatum*. (3) *Opisthorchis* (*Distoma*) *felineus*, which is found in Prussia and Siberia, and by Ward in cats in Nebraska. (4) *Opisthorchis noverca—Distomum conjunctum*—the Indian liver fluke described in man by McConnell. (5) *Opisthorchis* (*Distoma*) *sinensis*, which is by far the most important of the liver flukes and occurs extensively in Japan, China, and India. It is 10 to 20 mm. long by 2 to 5 mm. broad. The eggs are oval, 27 μ to 30 μ by 15 μ to 17 μ, dark brown, with sharply defined operculum. ~~A number of~~ Imported cases have been found in Canada and the United States. White found 18 cases in San Francisco.

The *symptoms* of hepatic distomiasis are best described in connection with the last form. The following account is abstracted from Wallace Taylor. Young children are the chief sufferers. Many members of a family are usually affected. In some villages a large proportion of the inhabitants are attacked. Among important symptoms is an irregular, intermittent diarrhœa; at first there may or may not be blood. The liver enlarges and a condition of cirrhosis gradually comes on. There may be pain and an intermittent jaundice. There is not much fever. After lasting for two or three years dropsy comes on, with anasarca and ascites. Even then transient recovery may

v2

Fin. nam. Celsus.

Mauss. B.H.J. 1917. [illegible]

Museum
B.M. July 28.97 Schistoma mansoni.

S. japonicum – Develops in a mollusc – disease especially
working in wading in rice fields.

S. haematobium – emerging from terminal spined egg – the
miracidium enters the liver of a fresh water mollusc
(Planorbis Bulinus) remains in mid-gut cells of host
& transforms into a sporocyst & daughter sporocysts ultimately
of cercariae develop. These escape into water – penetrate skin of man,
get to liver – in 6–10 weeks sexl. maturity, becoming adult
schistosome – getting ventr. suckers & produce terminal spined
eggs which escape with faeces into water
Also – Human urine pass – Lateral spined – found only in Africa.
new species S. mansoni – This infects a snail preferably human.
In West Indies & Brazil. – cases of Lateral spined S. Mansoni.

take place, but as a rule there is a recurrence, and the patient dies after many years of illness. The ova of the parasite are readily found in the stools.

3. Intestinal Distomiasis.—In India the *Fasciolopsis* (*Distoma*) *buskii* has been found in a number of cases in the small intestines. The *Mesogonimus heterophyes* has been found in Egypt and Japan.

The *Asiatic Amphistome—Gastrodiscus* (*Amphistoma*) *hominis*—a not uncommon parasite in India—is easily recognized by its large posterior sucker.

4. Hæmic Distomiasis; Bilharziasis.—One of the most important of parasitic diseases, caused by the blood fluke, *Schistosomum hæmatobium* or *Bilharzia hæmatobia*. Endemic hæmaturia has been known for many years, particularly in Egypt, where in 1851 Bilharz discovered the parasite of the disease. It prevails in South and North Africa, particularly the latter, in Arabia, Persia, and the west coast of India. Imported cases are not very uncommon in Europe, and an occasional instance is met with in the United States. In Egypt, among 11,698 patients admitted to the Cairo Hospital, 1,270 were infected, practically 10 per cent. (Madden). Of 500 autopsies at the same hospital, in 8 per cent. death was due to the effects of Bilharzial disease. The seriousness of the condition in Egypt is well illustrated by the fact that in 7.5 per cent. of army recruits the ova are found in the urine. An Asiatic blood fluke, *Schistosomum japonicum*, has recently been discovered which differs in small details from the African variety.

The *parasite* is singular among flukes in having the sexes separate, and the male usually carries the female in a gynæcophorous canal. The mode of entrance into the body is unknown, whether by the mouth, the urethra, or through the skin. The eggs are very characteristic, oval in shape, 0.16 mm. by 0.06 mm., and one end has a terminal spine. The eggs hatch in water, but the further development of the free-swimming embryos has not been followed. Taken into the body, possibly with water or on cresses, it reaches the portal veins, in which the worms are most commonly found, usually young specimens and uncoupled. The males bearing the females creep to various parts, particularly the bladder and rectum. The vesiculæ seminales may be first attacked. The eggs are laid in the tissues, but wander, like other sharp foreign bodies, and escape with the urine and fæces. A majority of them remain in the tissues and cause irritation, fibroid changes, and papillomata in the bladder and rectum. Collecting in the bladder as foreign bodies they form the nuclei of calculi.

Symptoms.—As is so often the case with animal parasites, they may cause no inconvenience. Irritability of the bladder, dull pain in the perineum, and hæmaturia are the most frequent symptoms. A chronic cystitis follows when the walls of the bladder are much thickened by the irritation caused by the ova. The anæmia caused by the hæmorrhage is slight in comparison with that of ankylostomiasis. When the rectum is involved there are straining and tenesmus, with the passage of mucus and blood; in severe cases large papillomata form and a chronic ulcerative proctitis. There may be a chronic vaginitis.

Of the complications, calculi in kidney and bladder are the most important. Milton, Madden, and others of the Cairo School of Medicine have studied carefully the surgical aspects of the disease. Periurethral abscess and perineal fistulæ are very common in the chronic cases.

Few symptoms are caused by the presence of the parasites in the portal veins, but there may be an advanced cirrhosis of a Glissonian type due to an enormous thickening of the periportal tissues (Symmers). This author has also reported an instance of the Bilharzia in the pulmonary blood in a case of Bilharzial colitis, and the worms were found living in the pulmonary circulation.

The diagnosis is readily made by finding the characteristic ova in the bloody urine or in the blood and mucus from the rectum. The Bilharzia may be present in the body for years without producing serious damage, and in slight infections the symptoms may disappear (Sandwith), particularly in children.

5. Schistosoma japonicum vel cattoi.—In China and Japan and in the Philippines there is a disease characterized by cirrhosis of the liver, splenomegaly, ascites, dysentery, progressive anæmia, and sometimes by focalized epilepsy. It occurs extensively in one district of Japan, and is known as the "Katayama" disease. Woolley has met with it in the Philippines, and Catto in China. It seems that the so-called urticarial fever, which is not very uncommon in China and Japan, is associated with the presence of this parasite, and an eosinophilia with fever and urticaria should lead to a careful examination of the stools for its eggs. The parasite lives in the vessels of the alimentary canal; the ova are smaller than those of *S. hæmatobium*, and have not the characteristic spinous ends.

Treatment.—We know of nothing which can kill the parasites in the blood. Extract of male fern is recommended for the hæmaturia. The chronic cystitis and proctitis demand the usual measures for these disorders.

II. DISEASES CAUSED BY CESTODES—TÆNIASIS

Man harbors the adult parasites in the small intestine, the larval forms in the muscles and solid organs.

1. INTESTINAL CESTODES; TAPEWORMS

Tænia solium (Pork Tapeworm).—This is not a common form in the United States. It is not uncommon in Panama. It is more frequent in parts of Europe and Asia. When mature it is from 6 to 12 feet in length. The head is small, round, not so large as the head of a pin, and provided with four sucking disks and a double row of hooklets; hence it is called, in contradistinction to the other form in man, the armed tapeworm. To the head succeeds a narrow, thread-like neck, then the segments, or proglottides, as they are called. The segments possess both male and female generative organs, and at about the four-hundred-and-fiftieth they become mature and contain ripe ova. The worm attains its full growth in from three to three and a half months, after which time the segments are continuously shed and appear in the stools. The segments are about 1 cm. in length and from 7 to 8 mm. in breadth. Pressed between glass plates the uterus is seen as a median stem with about eight to fourteen lateral branches. There are many thousands of ova in each ripe segment, and each ovum consists of a

firm shell, inside of which is a little embryo, provided with six hooklets. The segments are continuously passed, and if the ova are to attain further development they must be taken into the stomach, either of a pig, or of man himself. The egg-shells are digested, the six-hooked embryos become free, and passing from the stomach reach various parts of the body (the liver, muscles, brain, or eye), where they develop into the larvæ or cysticerci. A hog under these circumstances is said to be *measled,* and the cysticerci are spoken of as measles or bladder worms.

Tænia solium received its name because it was thought to exist as a solitary parasite in the bowel, but two or three or even more worms may occur.

Tænia saginata or Mediocanellata (Unarmed, Fat, or Beef Tapeworm.)—This is a longer and larger parasite than *Tænia solium.* It is certainly the common tapeworm of North America. Of scores of specimens which I have examined almost all were of this variety. According to Bérenger-Féraud it has spread rapidly in western Europe, owing probably to the importation of beef and live-stock from the Mediterranean basin. It may attain a length of 15 or 20 feet, or more. The head is large in comparison with that of *Tænia solium,* and measures over 2 mm. in breadth. It is square-shaped and provided with four large sucking disks, but there are no hooklets. The ripe segments are from 17 to 18 mm. in length and from 8 to 10 mm. in breadth. The uterus consists of a median stem with from fifteen to thirty-five lateral branches, which are given off more dichotomously than in *Tænia solium.* The ova are somewhat larger, and the shell is thicker, but the two forms can scarcely be distinguished by their ova. The ripe segments are passed as in *Tænia solium,* and are ingested by cattle, in the flesh or organs of which the eggs develop into the bladder worms or cysticerci.

Of other forms of tapeworm may be mentioned:

Dipylidium caninum (Tænia elliptica, Tænia cucumerina).—A small parasite very common in the dog and occasionally found in man; the larvæ develop in the lice and fleas of the dog.

Hymenolepis diminuta (Tænia flavo-punctata).—This small cestode was found in the intestine of a child in Boston, and has since been met with in twelve cases (Ransom). It is common in rats. The larvæ develop in *Lepidoptera* and in beetles.

Hymenolepis nana (Tænia nana) occurs not infrequently in Italy. It is not very uncommon in the United States (Stiles). The *Davainea madagascariensis* (*Tænia madagascariensis*) is a rare form.

Tænia confusa, a new species described by Ward.

Dibothriocephalus latus.—A cestode worm found only in certain districts bordering on the Baltic Sea, in parts of Switzerland, and in Japan. Nickerson has shown that it is common among the Finns in the Northwestern States, and it seems not improbable that the fish in the Great Lakes have become infected, as cases have increased of late years. The parasite is large and long, measuring from 25 to 30 feet or more. Its head is different from that of the tænia, as it possesses two lateral grooves or pits and has no hooklets. The larvæ develop in the peritoneum and muscles of the pike and other fish, and ~~it has been shown experimentally that they~~ grow into the adult worm when eaten by man.

Symptoms of Tapeworm Infection.—These parasites are found at all

ages. They are not uncommon in children and are occasionally found in sucklings. W. T. Plant refers to a number of cases in children under two years, and there is one in the literature in which it is stated that the tapeworm was found in an infant five days old!

The parasites may cause no disturbance and are rarely dangerous. A knowledge of the existence of the worm is generally a source of worry and anxiety; the patient may have considerable distress and complain of abdominal pains, nausea, diarrhœa, and sometimes anæmia. Occasionally the appetite is ravenous. In women and in nervous patients the constitutional disturbance may be considerable, and we not infrequently see great mental depression and even hypochondria. Various nervous phenomena, such as chorea, convulsions, or epilepsy, are believed to be caused by the parasites. Such effects, however, are very rare. The *Dibothriocephalus* may cause a severe and even fatal form of anæmia, which has been described fully in the monograph of Schaumann, of Helsingfors. It has been suggested that the metabolic products of the worm may have in some cases a hæmolytic action. Eosinophilia may occur.

Diagnosis.—The diagnosis is never doubtful. The presence of the segments is distinctive. The ova, too, may be recognized in the stools. ~~It makes but little difference as to the form of tapeworm, but~~ The ripe segments of *Tænia saginata* are larger and broader, and show differences in the generative system as already mentioned.

Prophylaxis.—The prophylaxis is most important. Careful attention should be given to three points. First, all tapeworm segments should be burned; they should never be thrown into the water-closet or outside; secondly, careful inspection of meat at the abattoirs; and, thirdly, cooking the meat sufficiently to kill the parasites.

In the case of the beef measles, the distribution of the parasites, as given by Ostertag, shows that the muscles of the jaw are much more frequently affected than other parts—360 times—while other organs were infected but 55 times. Sometimes there are instances of general infection. In Berlin the proportion of cattle infected in 1892-'93 was about 1 to 672. Cold storage kills the cysticercus usually within three weeks. The measles are more readily overlooked in beef than in pork, as they do not present such an opaque white color.

In the examination of hogs for cysticerci "particular stress should be laid upon the tongue, the muscles of mastication, and the muscles of the shoulder, neck, and diaphragm" (Stiles). They may be seen very easily on the under surface of the tongue. American hogs are comparatively free. In Prussia one hog is infected in about every 637. Specimens have been found alive twenty-nine days after slaughtering. In the examination of 1,000 hogs in Montreal, Clement and I found 76 instances of cysticerci. For full details with reference to the inspection of meat for animal parasites, the practitioner is referred to the work of Dr. Stiles, in Bulletin No. 19, United States Department of Agriculture, 1898.

Treatment.—Three days should be given to preparation for treatment, whatever drug is employed. For two days the patient should take soft food and the third day liquids only. The bowels should be well moved by castor oil taken each evening and a saline in the morning if necessary. Unless the

bowels have moved freely an enema should be given. On the third night a laxative, such as cascara, should be taken. There are many drugs, but male fern is usually the most reliable, given in the form of the ethereal extract. This is taken early in the morning of the fourth day before any food is taken. The usual dose is ʒi (4 c. c.), which is repeated in an hour. It may be given in capsules or in glycerine (ʒ ss, 15 c. c.). If there is fear of nausea a cup of coffee may be taken before the drug. After taking the male fern the patient should remain quiet and resist any desire to vomit. One hour after the second dose of male fern a full dose of saline is taken (magnesium or sodium sulphate, or magnesium citrate), and an hour later a second dose if the bowels have not moved. Great care should be taken during the expulsion of the worm, which should be passed into a chamber containing water at about the body temperature, a practice recommended by Celsus.

The pomegranate root is a very efficient remedy, and may be given as an infusion of the bark, 3 ounces of which may be macerated in 10 ounces of water and then reduced to one-half by evaporation. The entire quantity is then taken in divided doses. It occasionally produces colic, but is a very effective remedy. The active principle, pelletierine, is now much employed as the tannate, given in doses of 6 to 8 or even 10 grains (0.4 to 0.6 gm.), and followed in an hour by a purge.

Pumpkin seeds are sometimes very efficient. Three or four ounces should be carefully bruised and then macerated for twelve or fourteen hours, and the entire quantity taken and followed in an hour by a purge. Of other remedies, cusso, naphthalein (gr. v, 0.3 gm.), turpentine in ounce doses in honey, and kamala may be mentioned. Sometimes a combination of remedies is effectual when one fails. In children the use of pumpkin seeds or pelletierine is generally best. One cause of failure is the use of drugs which are old and inert.

Unless the head is brought away, the parasite continues to grow, and within a few months the segments again appear. Some instances are extraordinarily obstinate. Doubtless almost everything depends upon the exposure of the worm. The head and neck may be thoroughly protected beneath the valvulæ conniventes, in which case the remedies may not act. Owing to its armature *Tænia solium* is more difficult to expel. It is probable that no degree of peristalsis could dislodge the head, and unless the worm is killed it does not let go its extraordinarily firm hold on the mucous membrane. Owing to the danger of cysticercosis, treatment should not be delayed in case of infection with *Tænia solium*.

2. SOMATIC TÆNIASIS

Whereas adult tænia may give rise to little or no disturbance, and rarely, if ever, prove directly fatal, the affections caused by the larvæ or immature forms in the solid organs are serious and important. There are two chief cestode larvæ known to frequent man: (*a*) the *Cysticercus cellulosæ*, the larva of *Tænia solium*, and (*b*) the *Echinococcus*, the larva of *Tænia echinococcus*. The *Cysticercus tæniæ saginatæ* has been found only two or three times in man.

Cysticercus cellulosæ.—When man accidentally takes into his stomach

the ripe ova of *Tænia solium* he is liable to become the intermediate host, a part usually played for this tapeworm by the pig. This accident may occur in an individual the subject of *Tænia solium*, in which case the mature proglottides either themselves wander into the stomach or, what is more likely, are forced into the organ in attacks of prolonged vomiting. Of course the accidental ingestion from the outside of a few ova is quite possible, and the liability of infection should always be borne in mind in handling the segments of the worm.

The symptoms depend entirely upon the number of ova ingested and the localities reached. In the hog the cysticerci produce very little disturbance. The muscles, the connective tissue, and the brain may be swarming with the measles, as they are called, and yet the nutrition is maintained and the animal does not appear to be seriously incommoded. In the invasion period, if large numbers of the parasites are taken, there is, in all probability, constitutional disturbance; certainly this is seen in the calf, when fed with the ripe segments of *Tænia saginata*.

In man a few cysticerci lodged beneath the skin or in the muscles give no trouble, and in time the larvæ die and become calcified. They are occasionally found in dissection subjects or in post mortems as ovoid white bodies in the muscles or subcutaneous tissue. In America they are very rare. I saw but one instance in my post mortem experience. Depending on the number and the locality specially affected, the symptoms may be grouped into general, cerebro-spinal, and ocular. In 155 cases compiled by Stiles, the parasite in 117 was found in the brain, in 32 in the muscles, in 9 in the heart, in 3 in the lungs, subcutaneously in 5, in the liver in 2.

1. General.—As a rule the invasion of the larvæ in man, unless in very large numbers, does not cause very definite symptoms. It occasionally happens, however, that a striking picture is produced. A patient was admitted to my wards very stiff and helpless, so much so that he had to be assisted upstairs and into bed. He complained of numbness and tingling in the extremities and general weakness, so that at first he was thought to have a peripheral neuritis. At the examination, however, a number of painful subcutaneous nodules were discovered, which proved on excision to be the cysticerci. Altogether 75 could be felt subcutaneously, and from the soreness and stiffness they probably existed in large numbers in the muscles. There were none in his eyes, and he had no brain symptoms.

2. Cerebro-spinal.—Remarkable symptoms may result from the presence of the cysticerci in the brain and cord. In the silent region they may be abundant without producing any symptoms. I have in my possession the brain of a pig containing scores of "measles," yet the animal in the few moments in which I saw it just prior to death did not present any symptoms to attract attention. In the ventricles of the brain the cysticerci may attain a considerable size, owing to the fact that in regions in which they are unrestrained in their growth, as in the peritoneum, the bladder-like body grows freely. When in the fourth ventricle remarkable irritative symptoms may be produced. In 1884 I saw with Friedländer in Berlin a case from Riess's wards in which during life there had been symptoms of diabetes and anomalous nervous symptoms. Post mortem, the cysticercus was found beneath the valve of Vieussens, pressing upon the floor of the fourth ventricle.

Isabelle. Lampe d'Aurec ?

3. Ocular.—Since von Graefe demonstrated the presence of the cysticercus in the vitreous humor many cases have been placed on record, as it is a condition easily recognized.

Except in the eye, the diagnosis can rarely be made; when the cysticerci are subcutaneous one may be excised. It is possible that when numerous throughout the muscles they may be seen under the tongue, in which situation they may exist in the pig in numbers.

Echinococcus Disease.—The hydatid worms or echinococci are the larvæ of *Tænia echinococcus* of the dog. This is a tiny cestode not more than 4 or 5 mm. in length, consisting of only three or four segments, of which the terminal one alone is mature, and has a length of about 2 mm. and a breadth of 0.6 mm. The head is small and provided with four sucking disks and a rostellum with a double row of hooklets. This is an exceedingly rare parasite in the dog. Cobbold states that he has never met with a natural specimen in England. Leidy had not one in his large collection. I did not meet with an instance in America; Curtice, of Washington, found it once in an American dog. The worms are so small that they may be readily overlooked, since they form small, white, thread-like bodies closely adherent among the villi of the small intestines. The ripe segment contains about 5,000 eggs, which attain their development in the solid organs of various animals, particularly the hog and ox, more rarely the horse and the sheep. In some countries man is a common intermediate host, owing to the accidental ingestion of the ova.

Development.—The little six-hooked embryo, freed from the egg-shell by digestion, burrows through the intestinal wall and reaches the peritoneal cavity or the muscles; it may enter the portal vessels and be carried to the liver. It may enter the systemic vessels, and, passing the pulmonary capillaries, as it is protoplasmic and elastic, may reach the brain or other parts. Once having reached its destination, it undergoes the following changes: The hooklets disappear and the little embryo is gradually converted into a small cyst which presents two distinct layers—an external, laminated, cuticular membrane or capsule, and an internal, granular, parenchymatous layer, the endocyst. The little cyst or vesicle contains a clear fluid. There is more or less reaction in the neighboring tissues, and the cyst in time has a fibrous investment. When this primary cyst or vesicle has attained a certain size, buds develop from the parenchymatous layer, which are gradually converted into cysts, presenting a structure identical with that of the original cyst, namely, an elastic chitinous membrane lined with a granular parenchymatous layer. These secondary or daughter cysts are at first connected with the lining membrane of the primary cyst, but are soon set free. In this way the parent cyst as it grows may contain a dozen or more daughter cysts. Inside these daughter cysts a similar process may occur, and from buds in the walls granddaughter cysts are developed. From the granular layer of the parent and daughter cysts buds arise which develop into brood capsules. From the lining membrane the little outgrowths arise and gradually develop into bodies known as scolices, which represent in reality the head of the *Tænia echinococcus* and present four sucking disks and a circle of hooklets. Each scolex is capable when transferred to the intestines of a dog of developing into an adult tapeworm. The difference between the ovum of an ordinary tapeworm, such

as *Tænia solium*, and *Tænia echinococcus* is in this way very striking. In the former case the ovum develops into a single larva—*Cysticercus cellulosæ*—whereas the egg of *Tænia echinococcus* develops into a cyst which is capable of multiplying enormously and from the lining membrane of which millions of larval tapeworms develop. Ordinarily in man the development of the echinococcus takes place as above mentioned and by an endogenous form in which the secondary and tertiary cysts are contained within the primary; but in animals the formation may be different, as the buds from the primary cyst penetrate between the layers and develop externally, forming the exogenous variety. A third form is the multilocular echinococcus, in which form the primary cyst buds develop which are cut off completely and are surrounded by thick capsules of a connective tissue, which join together and ultimately form a hard mass represented by strands of connective tissue inclosing alveolar spaces about the size of peas or a little larger. In these spaces are found the remnants of the echinococcus cyst, occasionally the scolices or hooklets, but they are often sterile.

The fluid is limpid, non-albuminous; specific gravity 1.005 to 1.009, occasionally higher. It may contain sugar and succinic acid, and, after repeated tapping of the cyst, albumin. When not degenerated the hydatid heads or the characteristic hooklets are found in the contents of the cyst.

Changes in the Cyst.—It is not known definitely how long the echinococcus remains alive, probably many years, possibly as long as twenty years. The most common change is death and the gradual inspissation of the contents and conversion of the cyst into a mass containing putty-like or granular material which may be partially calcified. Remnants of the chitinous cyst wall or hooklets may be found. These obsolete hydatid cysts are not infrequently found in the liver. A more serious termination is rupture, which may take place into a serous sac, or perforation may take place externally when the cysts are discharged, as into the bronchi or alimentary canal or urinary passages. More unfavorable are the instances in which rupture occurs into the bile-passages or into the inferior cava. Recovery may follow the rupture and discharge of the hydatids externally. Sudden death has been known to follow the rupture. A third and very serious mode of termination is suppuration, which may occur spontaneously or follow rupture and is found most frequently in the liver.

Geographical Distribution of the Echinococcus.—The disease prevails most extensively in those countries in which man is brought into close contact with the dog, particularly when, as in Australia, the dogs are used for herding sheep, the animal in which the larval form of *Tænia echinococcus* is most often found. In Iceland the cases are very numerous. In Europe the disease is not uncommon. In Great Britain and in North America it is rare, and a majority of the cases are in foreigners. Statistics of the prevalence of the disease in America have been published by Osler (1882), Sommer (1895-'96), and by Lyon (1902), who has collected 241 cases. Of these, 136 cases were in foreigners; in 92 the nationality was not stated; 10 were negroes; 2 Canadians, and only 1 a native American. Fifty-six cases occurred in Manitoba, in which province there is a large settlement of Icelanders, who have brought the disease with them. Only one instance is known in a Canadian-born offspring of an Icelandic emigrant.

Distribution in the Body.—Of 1,634 cases comprised in the statistics of Davaine, Böcker, Finsen, and Neisser, the parasite existed in the liver in 820; in the lung or pleura in 137; in the abdominal organs, including the kidneys, bladder, and genitalia, in 334; in the nervous system in 122; in the circulatory system in 42; in other organs 179. Of the 241 cases in Lyon's series in America the liver was the seat in 177, and the omentum, peritoneal cavity, and mesentery in 26. In 11 cases cysts were passed per rectum, in 7 cases cysts or hooklets were expectorated, and in 2 cases passed per urethram.

Symptoms.—1. *Hydatids of the Liver.*—Small cysts may cause no disturbance; large and growing cysts produce signs of tumor of the liver with great increase in the size of the organ. Naturally the physical signs depend much upon the situation of the growth. Near the anterior surface in the epigastric region the tumor may form a distinct prominence and have a tense, firm feeling, sometimes with fluctuation. A not infrequent situation is to the left of the suspensory ligament, the resulting tumor pushing up the heart and causing an extensive area of dulness in the lower sternal and left hypochondriac regions. In the right lobe, if the tumor is on the posterior surface, the enlargement of the organ is chiefly upward into the pleura and the vertical area of dulness in the posterior axillary line is increased. Superficial cysts may give what is known as the hydatid fremitus. If the tumor is palpated lightly with the fingers of the left hand and percussed at the same time with those of the right, there is felt a vibration or trembling movement which persists for a certain time. It is not always present, and it is doubtful whether it is peculiar to the hydatid tumors or is due, ~~as Briançon held,~~ to the collision of the daughter cysts. Very large cysts are accompanied by feelings of pressure or dragging in the hepatic region, sometimes actual pain. The general condition of the patient is at first good and the nutrition little, if at all, interfered with. Unless some of the accidents already referred to occur, the symptoms ~~indeed~~ may be trifling and due only to the pressure or weight of the tumor.

Historically, one of the most interesting cases is that of the first Lord Shaftesbury (Achitopel), who had a tumor below the costal border for many years. It suppurated and was opened by the philosopher John Locke, his physician, who describes with great detail the escape of the bladder-like bodies. Among the Shaftesbury papers in the Record Office are several other cases collected by Locke; the disease may have been more common in England at that period.

Suppuration of the cyst changes the clinical picture into one of pyæmia. There are rigors, sweats, more or less jaundice, and rapid loss of weight. Perforation may occur into the stomach, colon, pleura, bronchi, or externally, and in some instances recovery has taken place. Perforation has occurred into the pericardium and inferior vena cava; in the latter case the daughter cysts have been found in the heart, plugging the tricuspid orifice and ~~the~~ pulmonary artery. Perforation of the bile-passages causes intense jaundice, and may lead to suppurative cholangitis.

An interesting symptom connected with the rupture of hydatid cysts is the occurrence of urticaria, which may also follow aspiration of the cysts.

Brieger has separated a highly toxic material from the fluid, and to it the symptoms of poisoning may be due.

Diagnosis.—Cysts of moderate size may exist without producing symptoms. Large multiple echinococci may cause great enlargement with irregularity of the outline, and such a condition persisting for any time with retention of the health and strength suggests hydatid disease. An irregular, painless enlargement, particularly in the left lobe, or the presence of a large, smooth, fluctuating tumor of the epigastric region is also very suggestive, and in this situation, when accessible to palpation, it gives a sensation of a smooth elastic growth and possibly also the hydatid tremor. When suppuration occurs the clinical picture is really that of abscess, and only the existence of previous enlargement of the liver with good health would point to the fact that the suppuration was associated with hydatids. *Syphilis* may produce irregular enlargement without much disturbance in the health, sometimes also a very definite tumor in the epigastric region, but this is usually firm and not fluctuating. The clinical features may simulate *cancer* very closely. In a case which I reported the liver was greatly enlarged and there were many nodular tumors in the abdomen. The post mortem showed enormous suppurating hydatid cysts in the left lobe of the liver which had perforated the stomach in two places and also the duodenum. The omentum, mesentery, and pelvis also contained numerous cysts. As a rule, the clinical course of the disease would suffice to separate it clearly from cancer. Dilatation of the gall-bladder and hydronephrosis have both been mistaken for hydatid disease. In the former the mobility of the tumor, its shape, and the mucoid character of the contents suffice for the diagnosis. In some instances of hydronephrosis only the exploratory puncture could distinguish between the conditions. More frequent is the mistake of confounding a hydatid cyst of the right lobe pushing up the pleura with pleural effusion of the right side. The heart may be dislocated, the liver depressed, and dulness, feeble breathing, and diminished fremitus are present in both conditions. Frerichs lays stress upon the different character of the line of dulness; in the echinococcus cyst the upper limit presents a curved line, the maximum of which is usually in the scapular region. Suppurative pleurisy may be caused by the perforation of the cyst. If adhesions result, the perforation takes place into the lung, and fragments of the cysts or small daughter cysts may be coughed up. For diagnostic purposes the exploratory puncture should be used. As stated, the fluid is usually perfectly clear or slightly opalescent, the reaction is neutral, and the specific gravity varies from 1.005 to 1.009. It is non-albuminous, but contains chlorides and sometimes traces of sugar. Hooklets may be found either in the clear fluid or in the suppurating cysts. They are sometimes absent, however, as the cyst may be sterile.

2. *Echinococcus of the Respiratory System.*—Of 809 cases of single hydatid cyst collected by Thomas in Australia, the lung was affected in 134 cases. Of 241 American cases, in 16 the pleura or lung was affected. The larvæ may develop primarily in the pleura and attain a large size. The symptoms are at first those of compression of the lung and dislocation of the heart. The physical signs are those of fluid in the pleura. The line of dulness may be quite irregular. As in the echinococcus of the liver, the general

condition of the patient may be excellent in spite of the existence of extensive disease. Pleurisy is rarely excited. The cysts may become inflamed and perforate the chest wall. Cary and Lyon have analyzed 40 cases of primary echinococcus cyst of the pleura; death results in a majority of the cases from the toxæmia following the rupture and the absorption of the fluid or from the sepsis following suppuration.

Echinococci occur more frequently in the lung than in the pleura. If small, they may exist for some time without causing serious symptoms. In their growth they compress the lung and sooner or later lead to inflammatory processes, often to gangrene, and the formation of cavities which connect with the bronchi. Fragments of membrane or small cysts may be expectorated. Hæmorrhage is not infrequent. Perforation into the pleura with empyema is common. A majority of the cases are regarded during life as either phthisis or gangrene, and it is only the detection of the characteristic membranes or the hooklets which leads to the diagnosis. Of a series of 21 cases, 17 recovered; 5 of the cases suppurated (C. H. Fleming, Victoria, personal communication).

3. *Echinococcus of the Kidneys.*—In the collected statistics referred to above the genito-urinary system comes second as the seat of hydatid disease, though here the affection is rare in comparison with that of the liver. Of the 241 American cases, there were 17 in which the kidneys or bladder were involved. The kidney may be converted into an enormous cyst resembling a hydronephrosis.

The diagnosis is only possible by puncture and examination of the fluid. The cyst may perforate into the pelvis of the kidney, and portions of the membrane or cysts may be discharged with the urine, sometimes producing renal colic. I have reported a case in which for many months the patient passed at intervals numbers of small cysts with the urine. The general health was little if at all disturbed, except by the attacks of colic during the passage of the parasites.

4. *Echinococcus of the Nervous System.*—The common cystic disease of the choroidal plexuses has been mistaken for hydatids. Davies Thomas, of Australia, has tabulated 97 cases, including some of the *Cysticercus cellulosæ*. According to his statistics, the cyst is more common on the right than on the left side, and is most frequent in the cerebrum.

The symptoms, very indefinite, as a rule are those of tumor. Persistent headache, convulsions, either limited or general, and gradually developing blindness have been prominent features in many cases.

Multilocular Echinococcus.—This form merits a brief separate description, as it differs so remarkably from the usual type. It has been met with only in Bavaria, Württemberg, the adjacent districts of Switzerland, and in the Tyrol. Possett has reported 13 cases from von Rokitansky's clinic at Innsbruck. In the United States six cases have been described, chiefly in Germans. Delafield and Prudden's patient had lived there five years, and for a year before his death had been jaundiced. A fluctuating tumor was found in the right flank, apparently connected with the liver. This was opened, and death followed from hæmorrhage. In Oertel's case the patient had lived there ten years. He was deeply jaundiced, and had a tumor mass at the right border of the liver, which was enlarged. Bacon resected a cyst

from the left lobe of the liver. The primary tumor presents irregularly formed cavities separated from each other by strands of connective tissue, and lined with the echinococcus membrane. The cavities are filled with a gelatinous material, so that the tumor has very much the appearance of an alveolar colloid cancer. It is ~~quite~~ possible that a special form of tænia echinococcus represents the adult type of this peculiar parasite. This form is almost exclusively confined to the liver, and the symptoms resemble more those of tumor or cirrhosis. The liver is, as a rule, enlarged and smooth, not irregular as in ~~presence of~~ the ordinary echinococcus. Jaundice is a common ~~symptom~~ and. The spleen is usually enlarged; there is progressive emaciation, and toward the close hæmorrhages are common.

Treatment of Echinococcus Disease.—Medicines are of no avail. Post mortem reports show that in a considerable number of cases the parasite dies and the cyst becomes harmless. Operative measures should be resorted to when the cyst is large or troublesome. The simple aspiration of the contents has been successful in a large number of cases, and may be tried before the more radical procedure of incision and evacuation of the cysts. Suppuration has occasionally followed the puncture. Injections into the sac should not be practiced. ~~With modern methods~~ Surgeons now open and evacuate the echinococcus cysts with great boldness, and the Australian records, which are the most numerous and important on this subject, show that recovery is the rule in a large proportion of the cases. Suppurative cysts in the liver should be treated as abscess. Naturally the outlook is less favorable. The practical treatment of hydatid disease has been greatly advanced by Australian surgeons. The works of the Australian physicians, James Graham and Thomas, may be consulted for interesting details in diagnosis and treatment.

Sparganum mansoni is a larval bothriocephalus met with in Japan and China, usually in the subcutaneous tissues, the adult form of which is not known.

III. DISEASES CAUSED BY NEMATODES

1. ASCARIASIS

Ascaris lumbricoides, the most common human parasite, is found chiefly in children. The female is from 7 to 12 inches in length, the male from 4 to 8 inches. In form it is cylindrical, pointed at both ends, with a yellowish-brown, sometimes a slightly reddish color. Four longitudinal bands can be seen, and it is striated transversely. The ova, which are sometimes found in large numbers in the fæces, are small, brownish-red in color, elliptical, and have a very thick covering. They measure 0.075 mm. in length and 0.058 mm. in width. The life history has been demonstrated to be "direct"—*i. e.*, without intermediate host. The parasite occupies the upper portion of the small intestine. Usually not more than one or two are present, but occasionally they occur in enormous numbers. The migrations are peculiar. They may pass into the stomach, whence they may be ejected by vomiting, or they may crawl up the œsophagus and enter the pharynx, from which they may be withdrawn. A child under my care in the smallpox department of

dunkles

?. Ophiuchi medialis bright. Big. Nova.

Steward shows that it rises a. 1572 Sidereal minutes. Cannot
may from so long? ante meridiem

Oil of chenopodium very useful given castor's. Best with castor oil
15 drops in castor oil ℥j Rolled by mouth ℥ss at one time.

the Montreal General Hospital, during convalescence, withdrew in this way more than thirty round worms within a few weeks. In other instances the worm reaches the larynx, and has been known to produce fatal asphyxia, or, passing into the trachea, to cause gangrene of the lung. They may go through the Eustachian tube and appear at the external meatus. The worms have been found in extraordinary numbers in the bile-ducts. Remarkable specimens exist in the Dupuytren, the Wistar-Horner (Philadelphia), and the Netley Museums. Chalmers (Ceylon) and Leys (U. S. N.) have called attention to their importance in causing abscess of the liver. Ebstein reports certain markings, strangulations, on the round worms, as if they had been nipped in the bile-ducts! The bowel may be blocked, or in rare instances an ulcer may be perforated. Even the healthy bowel wall may be penetrated.

A peculiarly irritating substance, often evident to the sense of smell in handling specimens, is formed by the round worms. Peiper and others suggest that the nervous symptoms, sometimes resembling those of meningitis, are due to this poison. Chauffard, Marie, and Tauchon have gone still further, and report a remarkable condition of fever, intestinal symptoms, foul breath, and intermittent diarrhœa in connection with the presence of lumbricoides. They call it typho-lumbricosis. The febrile condition may continue for a month or more. There may be eosinophilia to 25 to 30 per cent., and in some cases a marked anæmia. The question of the toxins produced by intestinal parasites is still an open one.

A few parasites may cause no disturbance. In children there are irritative symptoms usually attributed to worms, such as restlessness, irritability, picking at the nose, grinding of the teeth, twitchings, or convulsions.

Treatment.—Care should be taken to avoid auto-infection by thorough washing after defecation, and those infected should not be allowed to prepare food or serve it to others. It is well to give soft diet on the day previous and ~~give~~ a dose of castor oil the night before treatment. *Santonin* is usually efficient, given in the morning in doses of one grain (0.065 gm.) for a small child, and three to five grains (0.2 to 0.3 gm.) for an adult. One to two grains of calomel should be given with it. Three hours later a good dose of saline should be given. This should be done two mornings in succession and repeated in a week if worms or eggs are again passed. The occasional ~~unpleasant~~ effects of santonin (yellow vision, vertigo) should be explained beforehand. If santonin is not effectual male fern or thymol may be given.

Oxyuris vermicularis (Thread-worm; Pin-worm).—This common parasite occupies the rectum and colon. The male measures about 4 mm. in length, the female about 10 mm. They produce great irritation and itching, particularly at night, symptoms which become intensely aggravated by the nocturnal migration of the parasites. The oxyuris may traverse the intestinal wall, and has been found in the peritoneal cavity, where they may form verminous tubercles in Douglas's fossa or peri-rectal abscesses.

The patients become extremely restless and irritable, the sleep is often disturbed, and there may be loss of appetite and anæmia. Though most common in children, the parasite occurs at all ages.

The worm is readily detected in the fæces. Infection probably takes place through the water, or possibly through salads, such as lettuce and cresses. A

person the subject of the worms passes ova in large numbers in the fæces, and the possibility of re-infection must be scrupulously guarded against.

Treatment.—Every care should be taken to avoid auto-infection or the infection of others, by care in cleansing the anus and perineum, and thorough washing of the hands after defecation. Auto-infection is often responsible for the persistence of the disease. Treatment must be directed to the removal of the worms both from the small intestine and rectum. Santonin and calomel are useful, given as in ascaris infection, and for several days. Thymol and naphthalein are also used. To remove the worms from the rectum injections are required which should be retained as long as possible; it is well to wash out the bowel before giving them and the injection need not be over six ounces. Cold solutions of salt and water, ice water, vinegar (1 to 40), infusion of quassia (one ounce of quassia chips to a pint of water), lime water, carbolic acid (1 to 500), may be employed and should be used daily for two weeks. For the itching, carbolated vaseline, the gall and opium ointment, or menthol (5 per cent.) in vaseline may be employed.

2. TRICHINIASIS

The *Trichina or Trichinella spiralis* in its adult condition lives in the small intestine. The disease is produced by the embryos, which pass from the intestines and reach the voluntary muscles, where they finally become encapsulated larvæ—muscle trichinæ. It is in the migration of the embryos (possibly from poisons produced by them) that the group of symptoms known as trichiniasis is produced.

The ovoid cysts were described in human muscle by Tiedemann in 1822, and by Hilton in 1832; the parasite was figured and named by Richard Owen. Leidy in 1845 described it in the pig. For a long time the trichina was looked upon as a pathological curiosity; but in 1860 Zenker discovered in a girl in the Dresden Hospital, who had symptoms of typhoid fever, both the intestinal and muscle forms, and established their connection with a serious and often fatal disease.

Description of the Parasites.—(*a*) Adult or intestinal form. The female measures from 3 to 4 mm.; the male, 1.5 mm., and has two little projections from the hinder end.

(*b*) The larva or muscle trichina is from 0.6 to 1 mm. in length and lies coiled in an ovoid capsule, which is at first translucent, but subsequently opaque and infiltrated with lime salts. The worm presents a pointed head and a somewhat rounded tail.

When flesh containing the trichinæ is eaten by man or by any animal in which the development can take place, the capsules are digested and the trichinæ set free. They pass into the small intestine, and about the third day attain their full growth and become sexually mature. Virchow's experiments have shown that on the sixth or seventh day the embryos are fully developed. The young produced by each female trichina have been estimated at several hundred. Leuckart thought that various broods are developed in succession, and that as many as a thousand embryos may be produced by a single worm. The time from the ingestion of the flesh containing

the muscle trichinæ to the development of the brood of embryos in the intestines is from seven to nine days. The female worm penetrates the intestinal wall and the embryos are probably discharged directly into the lymph spaces, thence into the venous system, and by the blood stream to the muscles, which constitute their seat of election. J. Y. Graham reviewed the question of the mode of transmission in an exhaustive monograph, and he gives strong arguments in favor of the transmission through the blood stream. They have been found in the blood early in the infection and since the demonstration of their presence by Herrick and Janeway they have been seen by a number of observers. After a preliminary migration in the intermuscular connective tissue they penetrate the primitive muscle-fibres, and in about two weeks develop into the full-grown muscle form. In this process an interstitial myositis is excited and gradually an ovoid capsule develops about the parasite. Two, occasionally three or four, worms may be seen within a single capsule. This process of encapsulation has been estimated to take about six weeks. Within the muscles the parasites do not undergo further change. Gradually the capsule becomes thicker, and ultimately lime salts are deposited within it. This change may take place in man within four or five months. In the hog it may be deferred for many years. The calcification renders the cyst visible, and, ~~since first seen by Tiedemann and Nelson,~~ these small, opaque, oat-shaped bodies ~~have been~~ familiar objects to *an* demonstrators of normal and morbid anatomy. The trichinæ may live within the muscles for an indefinite period. They have been found alive and capable of developing as late as twenty or even twenty-five years after their entrance into the system. In many instances, however, the worms are completely calcified. The trichina has been found or "raised" in twenty-six different species of animals (Stiles). Medical literature abounds in references to its presence in fish, earthworms, etc., but these parasites belong to other genera. In fæcal examinations for the parasite it is well to remember that the "cell body" of the anterior portion of the intestine is a diagnostic criterion of the *T. spiralis*. Experimentally, guinea-pigs and rabbits are readily infected by feeding them with muscle containing the larval form. Dogs are infected with difficulty; cats more readily. Experimentally, animals sometimes die of the disease if large numbers of the parasites have been eaten. In the hog the trichinæ, like the cysticerci, cause few if any symptoms. An animal the muscles of which are swarming with living trichinæ may be well nourished and healthy-looking. An important point also is the fact that in the hog the capsule does not readily become calcified, so that the parasites are not visible as in the human muscles.

The **anatomical changes** are chiefly in the voluntary muscles. The trichinæ enter the primitive muscle bundles, which undergo granular degeneration with marked nuclear proliferation. There is a local myositis, and gradually about the parasite a cyst wall is formed. These changes, as well as the remarkable alterations in the blood, have been described ~~in full~~ by Brown. Cohnheim ~~has~~ described a fatty degeneration of the liver and enlargement of the mesenteric glands. At the time of death, in the fourth or fifth week or later, the adult trichinæ are still found in the intestines.

Incidence.—Man is infected by eating the flesh of trichinous hogs. In Germany, where a ~~thorough and~~ systematic microscopic examination of all

swine flesh is made, the proportion of trichinous hogs is about 1 in 1,852. Statistics are not available in England. In America inspections have been made since 1892. The percentage of animals found infected has ranged from 1.04 to 1.95. In 1883, in conjunction with A. W. Clement, I examined 1,000 hogs at the Montreal abattoir, and found only 4 infected.

Modes of Infection.—The danger of infection depends entirely upon the mode of preparation of the flesh. Thorough cooking, so that all parts of the meat reach the boiling point, destroys the parasites; but in large joints the central portions are often not raised to this temperature. The frequency of the disease in different countries depends largely upon the habits of the people in the preparation of pork. In North Germany, where raw ham and *Wurst* are freely eaten, the greatest number of instances have occurred. In South Germany, France, and England cases are rare. In the United States the greatest number of persons attacked have been Germans. Salting and smoking the flesh are not always sufficient, and the Havre experiments showed that animals are readily infected when fed with portions of the pickled or the smoked meat as prepared in America. Carl Fraenkel, however, states that the experiments on this point have been negative, and that it is very doubtful if any cases of trichiniasis in Germany have been caused by American pork. Germany has yet to show a single case of trichiniasis due to pork of unquestioned American origin.

Frequency of Infection.—H. U. Williams, of Buffalo, made a thorough study of the muscle from 505 unselected autopsies, and found 27 cases of trichiniasis, 5.3 per cent. The subjects had all died of causes other than trichiniasis. This important study shows how widespread is the disease, and that in reality we frequently overlook the sporadic form.

The disease occurs in groups or outbreaks in which from a dozen to several hundred individuals are attacked, and in sporadic cases which have been shown of late years to be not infrequent. In the epidemics a large number of persons are infected from one source; in the two famous outbreaks of Hedersleben and Emersleben 337 and 250 individuals were attacked. In the United States Stiles estimates that there have been more than 1,000 small outbreaks. The discovery in my wards at the Johns Hopkins Hospital by T. R. Brown of the eosinophilia in the disease has led to the much more frequent detection of the sporadic cases, and this form of the disease is not at all uncommon in the United States.

Symptoms.—The ingestion of trichinous flesh is not necessarily followed by the disease. When a limited number are eaten only a few embryos pass to the muscles and may cause no symptoms. Well-characterized cases present a gastro-intestinal period and a period of general infection.

In the course of a few days after eating the infected meat there are signs of gastro-intestinal disturbance—pain in the abdomen, loss of appetite, vomiting, and sometimes diarrhœa. The preliminary symptoms, however, are by no means constant, and in some of the large epidemics cases have been observed in which they have been absent. In other instances the gastro-intestinal features have been marked from the outset, and the attack has resembled cholera nostras. Pain in different parts of the body, general debility, and weakness have been noted in some of the epidemics.

The invasion symptoms occur between the seventh and the tenth day,

Lung signs.

Schmidt + Rathmann Am. J. M. Sc. Oct. 15.

Stimulation of frontal sinuses

Pratt. J.A.M.A. 1915. 65 [illegible]

Salzer. J.A.M.A. 1916. 67. 575 - (14 cases)

Kennig in all. - leg reflexes absent in all (6 mos later also)
Tr. in blood in syph. Sh-Kleinb. 5. (rein 3 mo. after recovery)
blood conj. [illegible]
In one case bilateral cerebral - motor area in arm
Embryo in milk of [illegible] woman. All cured man stand.
always pus from frontal sin. and canal.
Pneu always [illegible] thrills due to reduction of
bilirubin by living tissue. always found by duodenal tube.
In all but 4 cases during disease
(small mod. alkaline) rotated 12 - 24 hrs.

David by Schmidt [illegible]

Serum pus removed by head marked effect in
cancer [illegible] = also removed toxic opinion in 48 hrs

sometimes not until the end of the second week. There is fever, except in very mild cases. Chills are not common. The thermometer may register 102° or 104°F., and the fever is usually remittent or intermittent. The migration of the parasites into the muscles excites a more or less intense myositis, which is characterized by pain on pressure and movement, and by swelling and tension of the muscles, over which the skin may be œdematous. The limbs are placed in the positions in which the muscles are in least tension. The involvement of the muscles of mastication and of the larynx may cause difficulty in chewing and swallowing. In severe cases the involvement of the diaphragm and intercostal muscles may lead to intense dyspnœa, which sometimes proves fatal. Œdema, a feature of great importance, may be early in the face, particularly about the eyes. Later it occurs in the extremities when the swelling and stiffness of the muscles are at their height. Profuse sweats, tingling and itching of the skin, and in some instances urticaria, have been described.

Blood.—A marked leucocytosis, which may reach above 30,000, is usually present. A special feature is the extraordinary increase in the number of eosinophilic cells, which may comprise more than 50 per cent. of all the leucocytes. There were in four years, in the Johns Hopkins Hospital, 7 cases in which the eosinophilia was most pronounced. In 4 of them the diagnosis was actually suggested by the great increase in the eosinophiles; in 1 case they reached 68 per cent. of the total number of leucocytes.

The general nutrition is much disturbed and the patient becomes emaciated and often anæmic, particularly in the protracted cases. The patellar tendon reflex may be absent. The patients are usually conscious, except in cases of very intense infection, in which the delirium, dry tongue, and tremor give a picture suggesting typhoid fever. In addition to the dyspnœa present in the severer infections, there may be bronchitis, and in the fatal cases pneumonia or pleurisy. In some epidemics polyuria has been a common symptom. Albuminuria is frequent.

The intensity and duration of the symptoms depend entirely upon the grade of infection. In the mild cases recovery is complete in from ten to fourteen days. In the severe forms convalescence is not established for six or eight weeks, and it may be months before the patient recovers the muscular strength. One patient in the Hedersleben epidemic was weak eight years after the attack.

Of 72 fatal cases in the Hedersleben epidemic, the greatest mortality occurred in the fourth and fifth and sixth weeks; namely, 52 cases. Two died in the second week with severe choleraic symptoms.

The mortality has ranged in different outbreaks from 1 or 2 per cent. to 30 per cent. ~~In the Hedersleben epidemic 101 persons died.~~ Among 456 cases reported in the United States there were 122 deaths.

The prognosis depends much upon the quantity of infected meat ~~which has been~~ eaten and the number of trichinæ which mature in the intestines. In children the outlook is more favorable. Early diarrhœa and moderately intense gastro-intestinal symptoms are, as a rule, more favorable than constipation.

Diagnosis.—The disease should always be suspected when a large birthday party or *Fest* among Germans is followed by cases of apparent typhoid

fever. The parasites may be found in the remnants of the ham or sausages used on the occasion. The worms may be discovered in the stools. The stools should be spread on a glass plate or black background and examined with a low-power lens, when the trichinæ are seen as small, glistening, silvery threads. In doubtful cases the diagnosis may be made by the removal of a small fragment of muscle, ~~under cocaine anæsthesia.~~ The disease may be mistaken for rheumatic fever, particularly as the pains are so severe on movement, but there is no special swelling of the joints. The great increase in the eosinophiles in the blood is a most suggestive point in diagnosis. The tenderness is in the muscles both on pressure and on movement. The intensity of the gastro-intestinal symptoms in some cases has led to the diagnosis of cholera. Many of the former epidemics were doubtless described as typhoid fever, which the severer cases, owing to the prolonged fever, the sweats, the delirium, dry tongue, and gastro-intestinal symptoms, somewhat resemble. The pains in the muscles, with tension and swelling, œdema, particularly about the eyes, and shortness of breath, are the most important diagnostic points.

Prophylaxis.—It is not definitely known how swine become diseased. It has been thought that they are infected from rats about slaughter-houses, but it is just as reasonable to believe that the rats are infected by eating ~~portions of~~ the trichinous flesh of swine. The swine should, so far as possible, be grain-fed, and not, ~~as is so common,~~ allowed to eat offal. The most satisfactory prophylaxis is the complete cooking of pork and sausages, and to this custom in England, France, South Germany, and the United States immunity is largely due.

Treatment.—If it has been discovered within twenty-four or thirty-six hours that a large number of persons have eaten infected meat, the indications are to thoroughly evacuate the gastro-intestinal canal. Calomel (gr. ii, 0.13 gm.) should be given at once and repeated in two hours. Four hours after the second dose half an ounce of castor oil or magnesium sulphate should be given and repeated if necessary. An enema should be given unless the bowels move freely. Glycerin has been recommended in large doses, in order that by passing into the intestines it may by its hygroscopic properties destroy the worm. Male fern, kamala, santonin, and thymol have all been recommended in this stage. Turpentine may be tried in full doses. There is no doubt that diarrhœa in the first week or ten days of the infection is distinctly favorable. The indications in the stage of invasion are to relieve the pains, to secure sleep, and to support the patient's strength. There are no medicines which have any influence upon the embryos in their migration through the muscles.

3. ANKYLOSTOMIASIS

(*Hookworm Disease*)

Synonyms.—One of the most important, widespread of all metazoan infections, variously known as uncinariasis; anæmia of miners, bricklayers, tunnel-workers; tropical and Egyptian chlorosis.

History.—For three centuries the disease, but not its nature, was recog-

nized in the tropics under various names. Dubini, in 1838, first described the worms, and gave the name from the curved or bent appearance of the mouth. In 1853 and 1854 Bilhartz and Griesinger recognized the relation of the parasites to the anæmia and dropsy. In South America in 1866 Wucherer called attention to the frequency of the disease in negro slaves. In the "seventies" and "eighties" of the last century the anæmia of brick-workers in Italy and of miners and tunnel diggers was shown to be due to this parasite. Occasional statements were made as to the occurrence of the disease in the United States, but it was not until the extensive investigations of Stiles in 1901, and later, that it was shown that the hookworm was widely prevalent, and that it was responsible for an enormous amount of ill health and anæmia, and that it was directly connected with the old and long-ago described practice of dirt-eating. The studies of Allen J. Smith and others showed how widespread was the disease in the Southern States. Ashford and King studied the disease in Porto Rico, and carried out one of the most successful of modern sanitary campaigns. In 1898 Looss discovered the cardinal fact of the penetration of the skin by the larvæ, and of the route by which they reach the intestine. His great work, one of the most important of recent contributions to helminthology, has just been completed (Part ii, 1911). Special clinical monographs have been published by Dock and Bass, by Ashford and Igaravidez, and by Boycott (all in 1911).

Distribution.—The parasite exists in most parts of the world, and recent studies show that there is scarcely a tropical country in which the disease caused by it does not prevail. In India the infection is from 60 to 80 per cent., in Porto Rico 90 per cent., in the Philippines about 15 per cent. In Europe it is chiefly an affection of miners in Germany, Hungary, France and Belgium. In England there was a small outbreak in Cornwall, but the disease has not extended. The Southern United States are badly infected. Stiles shows that more than 12 per cent. of cotton-mill employees are infected, and the examination of recruits, college students, and school children in different parts of the country gives a percentage of infection of from 20 to 70 or even 80.

Parasites.—There are two chief forms, the *Ankylostoma duodenale*, the old world species, and the *Necator americanus*, the new world species. The Ankylostoma is a small cylindrical nematode, the male about 10 mm. and the female from 10 to 18 mm. in length. The mouth has chitinous plates, and is provided with two pairs of sharp, hook-shaped teeth, with which they pierce the mucosa of the bowel. The male has a prominent, umbrella-like caudal expansion. The new world worm has much the same characters, only it is more slender, the mouth globular, and the arrangement of the teeth quite different. The eggs are from 52 μ to 60 μ by about 34 μ in width in the European form, and from 64 μ to 76 μ by about 36 μ in breadth in the American form. They are very characteristic bodies in the fæces of infected individuals. When laid they are already in process of segmentation. Complete dessication, and direct sunlight, or much water in the fæces kills the eggs; but they are sometimes very tenacious of life, and freezing, followed by a gentle thawing, may be resisted. The rapidity of development depends upon favoring conditions and temperature, and the larvæ after escaping from the eggs may live for months in the mud or

water of the mines, and they pass through a series of moults before they reach what is called the ripe stage. They then show a remarkable tenacity of life, and may live in water or slime for many months; and in this, which is the infective stage, they have a great tendency to wander.

Modes of Infection.—An extraordinary number of eggs are passed with each stool of a badly infected person, as many it has been estimated as four millions. They develop most readily in fæces mixed with sand or earth at a temperature of from 70° to 90°. The larvæ become infective when about 4 or 5 days old. Infection takes place either by the mouth directly, which is rare, or by the skin. Looss showed experimentally that the larvæ entering the skin are carried by the veins to the heart, and thence to the lungs, in which they escape from the pulmonary vessels, pass up the bronchi and trachea, and so to the gullet, stomach and intestines. These remarkable observations of Looss have been abundantly confirmed. As C. A. Smith's work has shown, it takes about seven weeks before the ova appear in the stools, and in the process of infection there may be sore throat and fever. It would appear that the skin is the common channel of entrance, and usually shows signs of irritation—ground itch. Larvæ accidentally swallowed may pass through the stomach, and develop in the intestines.

The careless disposition of the fæces permits the pollution of the soil, and in the tropical and sub-tropical districts, and in mines, it is an easy matter to understand how children and others are infected through the skin. Ashford and King give a history of more than 90 per cent. of ground-itch in their cases.

Morbid Anatomy and Pathology.—The worms are chiefly in the jejunum; Sandwith found 1,353 out of 1,524 worms in the first six feet of the bowel. They are also occasionally found in the stomach. A variable number of worms are found attached to the mucosa. Very characteristic lesions are the ecchymoses and small erosions of the mucosa, in the centre of which may be a pale area, slightly raised, to which the worm is attached; it may be almost buried in the mucosa. There are usually more bites or holes than worms. Blood cysts occur in the sub-mucosa, in which, occasionally, worms are found (Whipple). The contents of the bowel are often blood-stained. In long-standing cases the mucosa may show many areas of pigmentation. Other lesions are those of chronic anæmia with fatty degeneration. Much discussion has taken place as to whether the worms live on blood or not. They are certainly built for blood-sucking, and, as Whipple states, when the mucosa is normal the worms feed chiefly on blood, when it is thickened and infiltrated they have to be content with the epithelium and mucosa. The loss of blood is largely direct, but it has been shown by Loeb and A. J. Smith that the head-glands of the worm secrete a substance which retards coagulation, probably a hæmolytic poison, the presence of which Whipple has demonstrated. Another feature of importance is the liability to infection through the bites; and the anæmia may in part, at any rate, be due to poisonous products absorbed through the bowel lesions.

Symptoms.—The hookworm disease presents a very variable picture, nor does the severity of the symptoms seem to depend always upon the number of worms. There have been fatal cases in which only ten or twelve worms were found, while recovery has followed after more than 4,000 worms have

been expelled (Dock). In infected districts, as in the Southern States, the hookworm disease causes a widespread degeneration in the community, the children and young adults showing a pallor, under-development, and failure of nutrition. With the infection, too, are associated an apathy and lack of energy, so that the common opinion in the South is that the hookworm is the cause of laziness. There is no question that, as Stiles and others have shown, the widespread infection is responsible for a great deal of ill health and physical incapacity, often without any actual illness. In more severe cases the anæmia is pronounced, the hæmoglobin being from 40 to 50 per cent.; the child is stunted and puberty is long delayed, and the patient may belong to the group of dirt-eaters. The retardation of growth is remarkable, and the individual may continue to grow until he is 25 or 26 years of age. In the severest type of all the anæmia is still more pronounced; the hæmoglobin below 25 or 20 per cent.; œdema occurs, the patient is bedridden, and death occurs from exhaustion, diarrhœa, or some intercurrent affection. The *anæmia* is of a secondary type, averaging from 50 to 60 per cent. of the corpuscles, with, as a rule, a low color index. Leucocytosis is not often present, and the differential count shows nothing unusual except the great increase in the eosinophiles, ranging from 15 to 26 or even 30 per cent.

"Ground-itch," the local lesion through which the parasites enter the system, is most commonly on the feet and legs in children, or on the arms and hands in gardeners and miners. The most common region is between and beneath the toes. The eruption is vesicular at first, and then pustules form with a sticky exudate, and sometimes with much swelling of the skin. The vesicles and pustules gradually dry, and in about eight or ten days heal with exfoliation.

Other general features are the well known circulatory and respiratory features of anæmia. The digestive symptoms are remarkable. In the mild cases there are slight epigastric pain and discomfort; in the severer ones there are anorexia and remarkable perversion of appetite; the patients eat earth, paper, chalk, starch, hair and clay. The dirt-eaters of the Southern States are all subject to the hookworm disease. ~~Mental inertia has already been referred to, and popularly the affection is spoken of as the "lazy disease."~~ With the apathetic, listless expression there is dilatation of the pupils, and Stiles has remarked upon the "dull, blank, almost fish-like or cadaveric stare," which gives a very characteristic appearance to the expression.

Diagnosis.— In tropical and sub-tropical regions slight anæmia and ill health should lead to the examination of the stools, from which a certain diagnosis may be made by finding the eggs. "The combination of anæmia with under-development, weakness, dilated heart, and the history of ground-itch is not likely to be confused with anything else" (Stiles). In badly infected regions a fairly accurate diagnosis may be made on inspection alone, and the diagnosis may be confirmed in the examination of the fæces by the rapid improvement after the administration of thymol. Two or three drachms of fæces suffice; they should be collected in a wide-mouthed bottle. A little practice may be required at first, but the necessary technique is easily acquired. The eggs are characteristic structures, usually containing 4 or 8 segments, sometimes the complete embryo nearly ready to burst its shell. Various estimates have been made of the number of worms based on

the number of eggs found. It is to be remembered that the eggs vary greatly in numbers, and the stools may be negative one day and contain many a few days later. Grassi states that 150 eggs per centigram of fæces represent about 1,000 worms. For other special methods of examining the stools the student is referred to the monograph of Dock and Bass.

The presence of eosinophilia is an important diagnostic aid. Boycott and Haldane found that 94 per cent. of infected persons had over 8 per cent. of eosinophiles.

Prophylaxis.—Destruction of the adult worms, removing conditions suitable to the growth of the embryos, and a campaign of sanitary education are the three essentials. The proper disposal of fæces, obtaining a pure water supply, and decreasing the chance of infection by wearing shoes and stockings are important points. The work of the Porto Rico commission, inaugurated by Ashford and King, and carried on by Ashford, Igaravidez and their colleagues, shows what can be done in the tropics, even in the most unfavorable surroundings. The fighting unit in this battle has been the anæmia dispensary, of which 55 were established in Porto Rico, each one with a visiting nurse, and with provisions for the proper examination of the patients. ~~According to the last report, nearly 50,000 patients were treated in 1909-1910.~~ More than 300,000 persons have received specific treatment for the disease since the commission began its work. That the mortality in the island has fallen from 42 per 1,000 in 1899-1900 to 20.9 in 1910 is in great part due to the devoted work of the medical staff and the nurses in dealing with the hookworm disease.

In mines care should be taken to prevent local conditions favoring the growth of the embryos. Oliver has found that cinder and slag are destructive of the larvæ. New workers should be examined and proved not to have the disease before being admitted.

Treatment.—The following directions are given by the Porto Rican commission:

> **Take one of the two purgatives to-night in water.**
> **Take at 6 o'clock to-morrow morning half of the capsules (thymol).**
> **Take the other half at 8 o'clock the same morning.**
> **Take the other purgative at 10 o'clock.**
> **You should neither drink wine nor any alcoholic liquor during the time you are taking these medicines.**
> **Come for more medicine until the physician says you are cured.**
> **Have a privy in your house. Do not defecate on the surface of the ground, but in the privy.**
> **Do not walk barefooted, so that you may avoid contracting the disease in your feet. Wear shoes and you will never suffer from anæmia.**

The purgative preferred is an ordinary saline, and the dose of the thymol is graduated according to the age of the patient, seven grains (0.5 gm.) for children under five, and increasing the dose according to age and strength to sixty grains (4 gm.) for adults. Very few ill effects follow its use, but it sometimes is irritating to the bowels, and occasionally it has been toxic. This treatment should be carried out on one day of each week until the patient is cured. No alcohol or oil should be given at the time of administration of thymol.

Eucalyptus and chloroform may be given as Hermann's mixture (chloro-

W. 1 day Liq. diet. Ether Enem sulf. 10 mss
2 " work. 5 am. " " " 7. Y. 811. 15 drops of oil & sugar
1 PM 1 mss Castor oil with 50 min. chenopod

American wormseed oil.
oil of chenopodium (oleum chenopodii)
15 Drops with sugar every 2 hrs. for 3 doses. Give castor oil
2 hours after castor oil 3ss. Stupid passage. with it every
castor oil

chloroform very useful. Dose of 3to 4 gtts in castor oil Bell.

sep. 30

The forms of F. filaria are as follows:

A.M.N. July 28.07

Manson says F. philippinensis (adult ♀ only) resembles F. bancrofti

Manson gives also F. loa - eye-worm of tropical West Africa
causes "calabar swellings". M. says Daycan

F. loa. Appears identical with F. bancrofti. M. says Daycan
found they fly carries. Chrysops dimidiata. - (Philippines)

F. perstans ——— appears same as Acanthocheilonema perstans
F. demarquayi ——— common in tropics.
M. thinks Daycan dimidiata identical but not proved.

prob. no serious [illegible]

form 3 c. c., oil of eucalyptus 2 c. c., castor oil 40 c. c., taken in two doses at intervals of one hour). Beta-naphthol has been much used in doses of thirty grains (2 gm.) for adults. Male fern has also been given. The anæmia should receive the usual treatment.

4. FILARIASIS

For a full discussion of the zoölogical relations of this important group see Stiles' article in my "System of Medicine," Vol. I.

Under the general term *Filaria sanguinis hominis* three species of nematodes are included:

Filaria bancrofti Cobold, 1877. This is the ordinary blood filaria. The embryos are found in the peripheral circulation only during sleep or at night. The mosquito is the intermediate host. The embryos measure 270 to 340 μ long by 7 to 11 μ broad; tail pointed. The adult male measures 83 mm. long by 0.407 mm. broad; the tail forms two turns of a spiral. The adult female measures 155 mm. long by 0.715 mm. broad; vulva 2.56 mm. from anterior extremity; eggs 38 μ by 14 μ. This is the species to which the hæmatochyluria and elephantiasis are attributed.

Filaria diurna Manson, 1891. The larvæ agree with the preceding, except that Manson indicates the absence of granules in the axis of the body. The worms occur in the peripheral circulation only during the day, or when the patient stays awake. Manson suspects that the *Filaria loa* represents the adult stage.

Filaria perstans Manson, 1891. Only the embryos are known. These are much smaller than the preceding—200 μ long, posterior extremity obtuse, anterior extremity with a sort of retractile rostellum.

Manson is inclined to regard the *Filaria perstans* as the cause of *craw-craw*, a papillo-pustular skin eruption of the west coast of Africa, which is probably the same as Nielly's *dermatose parasitaire*, the parasite of which was called by Blanchard *Rhabditis niellyi*. Manson has shown that in the blood of the aboriginal Indians in British Guiana there are two forms of filarial embryos which differ somewhat from the ordinary types. Daniels and Ozzard have shown the extraordinary prevalence of these parasites in the aborigines—fully 58 per cent. Daniels has found the mature filaria in two subjects in the upper part of the mesentery, near the pancreas and in the subpericardial fat.

The most important of these is the *Filaria bancrofti*, which produces the hæmatochyluria and the lymph-scrotum.

The female produces an extraordinary number of embryos, which enter the blood current through the lymphatics. Each embryo is within its shell, which is elongated, scarcely perceptible, and in no way impedes the movements. They are about the ninetieth part of an inch in length and the diameter of a red blood-corpuscle in thickness, so that they readily pass through the capillaries. They move with the greatest activity, and form very striking and readily recognized objects in a blood-drop under the microscope. A remarkable feature is the periodicity in the occurrence of the embryos in the blood. In the daytime they are almost or entirely absent, whereas at night, in typical cases, they are present in large numbers. If, however, as Stephen Mackenzie has shown, the patient, reversing his habits,

sleeps during the day, the periodicity is reversed. In the case reported by Lothrop and Pratt the number of embryos per cubic centimetre of blood was calculated hourly during the night; it rose steadily from four o'clock in the afternoon till midnight, when 2,100 per c. c. were present, then fell, none being found at ten o'clock the following morning. The further development of the embryos is associated with the mosquito, which at night sucks the blood and in this way frees them from the body. ~~After developing a little it was thought that they were set free in the water by the death of the host.~~ S. P. James has found them in the tissues of the proboscis of the mosquito, and the infection is probably direct, as in malaria. The filariæ may be present in the body without causing any symptoms. In the blood of animals filariæ are very common and rarely cause inconvenience. It is only when the adult worms or the ova block the lymph channels that certain definite symptoms occur. Manson suggests that it is the ova (prematurely discharged), which are considerably shorter and thicker than the full-grown embryos, which block the lymph channels and produce the conditions of hæmatochyluria, elephantiasis, and lymph-scrotum.

The parasite is widely distributed, particularly in tropical and sub-tropical countries. Guitéras has shown that the disease prevails extensively in the Southern States, and since his paper appeared contributions have been made by Matas, of New Orleans, Mastin, of Mobile, De Saussure, of Charleston, and Opie.

The effects produced may be described under the following conditions:

1. Hæmatochyluria.—Without any external manifestations, and in many cases without special disturbance of health, the subject from time to time passes urine of an opaque white, milky appearance, or bloody, or a chylous fluid which on settling shows a slightly reddish clot. The condition indicates dilatation and rupture of dilated lymphatics in some part of the urinary tract and obstruction of the thoracic duct. The urine may be normal in quantity or increased. The condition is usually intermittent, and the patient may pass normal urine for weeks or months at a time. Microscopically, the chylous urine contains minute molecular fat granules, and usually red blood ~~corpuscles~~ cells in various amounts. The embryos were first discovered by Demarquay at Paris (1863), and in the urine by Wucherer, at Bahia, in 1866. It is remarkable for how long the condition may persist without serious impairment of the health. A patient, sent to me by Dawson, of Charleston, had hæmatochyluria intermittently for eighteen years. The only inconvenience had been in the passage of blood-clots which collected in the bladder. At times he had also uneasy sensations in the lumbar region. The embryos were present in his blood at night in large numbers. Chyluria is not always due to ~~the~~ filaria. The non-parasitic form of the disease is considered elsewhere.

Opportunities for studying the anatomical condition of these cases rarely occur. In the case described by Stephen Mackenzie the renal and peritoneal lymph plexuses were enormously enlarged, extending from the diaphragm to the pelvis. The thoracic duct above the diaphragm was impervious.

2. Elephantiasis is common in all countries in which the filariæ prevail. The parasites are not always found in the blood. The condition is more common in the legs, one or both, beginning below the knee, but grad-

Dermot Hall and Filicinia of Pacific islands. i.e. Pteridium
Lucana carried by dog migrants. a Stegomyia.
Culex fatigans in Asia, Africa & America - Aedes Scutellaris
as Culex. may carry in Pacific

(Elephanta's form).

ually involving the entire limb. Next in frequency is *lymph-scrotum* and other forms involving the genitalia. The *scrotal* tumor may reach an enormous size, and 40 to 50 pounds in weight. The onset may be painless and slow, or it may be sudden, with fever and rapid swelling and redness of the part. There may be a series of such attacks, each one leaving the part more swollen.

Sporadic Elephantiasis.—A non-parasitic type may be mentioned here, which is not very uncommon in temperate regions, characterized by progressive enlargement of a limb or portion of the body, due to a hyperplasia of the skin and subcutaneous tissues, due apparently to an obstructive inflammation of the lymph-vessels. It may arise spontaneously without any obvious cause, or it may follow an inflammation of the skin of the part, occasionally removal of the lymph-glands. The legs are most frequently involved, beginning usually in one leg, about the foot or ankle, and gradually extending until the whole leg is greatly enlarged. The skin is usually smooth, but it may be hard and indurated or warty and nodular. Most of the cases I have seen have been in young women, in whom the affection has come on without any obvious cause and progressed slowly until the leg was greatly enlarged. In one case six or eight years elapsed before the other leg became involved, and in another case more than ten years has passed and the disease is still confined to one leg.

Treatment.—So far as I know, no drug destroys the embryos in the blood. In infected districts the drinking-water should be boiled or filtered. In cases of chyluria the patients should use a dry diet and avoid all excess of fat. The chyle may disappear quite rapidly from the urine under these measures, but it does not necessarily indicate that the case is cured. So long as clots and albumin are present the leak in the lymphoid varix is not healed, although the fat, not being supplied to the chyle, may not be present. A single tumblerful of milk will at once give ocular proof of the patency or otherwise of the rupture in the varix (Manson).

Elephantoid fever demands rest, liquid diet, free purgation and sedative applications to painful areas. In *elephantiasis* during periods with acute symptoms the patient should be at rest and the legs firmly bandaged. Good results are reported from the use of fibrolysin.

The surgical treatment of some of these cases is most successful, particularly in the removal of the adult filariæ from the enlarged lymph-glands, especially in the groin. Maitland states that during seven years 25 operations of this kind have been performed without serious symptoms. Surgical measures may be advisable in elephantiasis.

5. DRACONTIASIS

(*Guinea-worm Disease*)

Dracunculus medinensis is a widely spread parasite in parts of Africa and the East Indies. In the United States instances occasionally occur. Jarvis reported a case in a post chaplain who had lived at Fortress Monroe, Va., for thirty years. Van Harlingen's patient, a man aged forty-seven, had never lived out of Philadelphia, so that the worm must be included

among the parasites of the United States. A majority of the cases reported in American journals have been imported.

The female develops in the subcutaneous and intermuscular connective tissues and produces vesicles and abscesses. In the large majority of the cases the parasite is found in the leg. Of 181 cases, in 124 the worm was found in the feet, 33 times in the leg, and 11 times in the thigh. It is usually solitary, though there are cases on record in which six or more have been present. It is cylindrical in form, about 2 mm. in diameter, and from 50 to 80 cm. in length. The male has been found by Leiper in a monkey, a very small worm only 22 mm. in length.

The worm gains entrance to the system through the stomach, not through the skin, as was formerly supposed. It is probable that both male and female are ingested; but the former dies and is discharged, while the latter after impregnation penetrates the intestine and attains its full development in the subcutaneous tissues, where it may remain quiescent for a long time and can be felt beneath the skin like a bundle of string. The worm contains an enormous number of living embryos, and to enable them to escape she travels slowly downward head first, and, as mentioned, usually reaches the foot or ankle. The head then penetrates the skin and the epidermis forms a little vesicle, which ruptures, and a small ulcer is left, at the bottom of which the head often protrudes. The distended uterus ruptures and the embryos are discharged in a whitish fluid. After getting rid of them the worm will spontaneously leave her host. In the water the embryos develop in the cyclops—a small crustacean—and it seems likely that man is infected by drinking the water containing these developed larvæ.

When the worm first appears it should not be disturbed, as after parturition it may leave spontaneously. When the worm begins to come out a common procedure is to roll it round a portion of smooth wood and in this way prevent the retraction, and each day wind a little more until the entire worm is withdrawn. It is stated that special care must be taken to prevent tearing of the worm, as disastrous consequences sometimes follow, probably from the irritation caused by the migration of the embryos.

The parasite may be excised entire, or killed by injections of bichloride of mercury (1 to 1,000). It is stated that the leaves of the plant called *amarpattee* are almost a specific in the disease. Asafetida in full doses is said to kill the worm.

6. OTHER NEMATODES

Filariæ.—Among less important filarian worms parasitic in man the following may be mentioned: *Filaria loa,* a cylindrical worm of about 3 cm. in length, whose habitat is beneath the conjunctiva. It has been found on the West African coast, in Brazil, and in the West Indies. *Filaria lentis,* which has been found in a cataract. Three specimens have been found together. *Filaria labialis,* which has been found in a pustule in the upper lip. *Filaria hominis oris,* which was described by Leidy, from the mouth of a child. *Filaria bronchialis,* which has been found occasionally in the trachea and bronchi. This parasite has been seen in a few cases in the bronchioles and in the lungs. There is no evidence that it ever produces

Larva passes into water entering body & fresh-water cyclops when it develops. - Exp. Comm: 11.d if the infected cyclops pass in 0.270 HCl - Kills but parasites stain deeply when cut. So infected cyclops given to monkey - worms found living around mouth, lobes. (Dimly Leiper)

So inf. acquired by drinking cyclops infected water - infected/ten carriers

an extensive verminous bronchitis similar to that which I have described in dogs. *Filaria immitis*—the common *Filaria sanguinis* of the dog—of which Bowlby has described two cases in man. In one case with hæmaturia female worms were found in the portal vein, and the ova were present in the thickened bladder wall and in the ureters.

Trichocephalus dispar (*Whip-worm*).—This parasite is not infrequently found in the cæcum and large intestine of man. It measures from 4 to 5 cm. in length, the male being somewhat shorter than the female. The worm is readily recognized by the remarkable difference between the anterior and posterior portions. The former, which forms at least three-fifths of the body, is extremely thin and hair-like in contrast to the thick hinder portion of the body, which in the female is conical and pointed, and in the male more obtuse and usually rolled like a spring. The eggs are oval, lemon-shaped, 0.05 mm. in length, and each is provided with a button-like projection.

The number of the worms found is variable, as many as a thousand having been counted. It is a widely spread parasite. In parts of Europe it occurs in from 10 to 30 per cent. of all bodies examined, but in the United States it is not so common. In 285 West Indian workers at Panama Darling found 46 per cent. infected. It is possible, he thinks, that these parasites play a rôle in amœbic dysentery, the lesions of which begin at the exact location of the points of their attachment. The trichocephalus rarely causes symptoms. French and Boycott found ova in 40 of 500 Guy's Hospital patients. They found no etiological relationship of the parasite to appendicitis. Several cases have been reported in which profound anæmia has occurred in connection with this parasite, usually with diarrhœa. Enormous numbers may be present, as in Rudolph's case, without producing any symptoms.

The diagnosis is readily made by the examination of the fæces, which contain, sometimes in great abundance, the characteristic lemon-shaped, hard, dark-brown eggs.

Dicotophyme renale (*Eustrongylus gigas*).—This enormous nematode, the male of which measures about a foot in length and the female about three feet, occurs in many animals and has occasionally been found in man. It is usually found in the renal region and may entirely destroy the kidney.

Anguillula aceti.—The Anguillula aceti, or vinegar eel, is sometimes present in the urine (in one case it is said from the bladder). It is probably a contamination from a dirty bottle in which the urine is collected.

Strongyloides intestinalis.—The parasite was discovered in 1876 by Normand, and is the same as was formerly described as Anguillula stercoralis and Rhabdonema intestinalis. It is a common parasite in tropical diarrhœa, particularly in Cochin China. It is found in about 3 per cent. of the medical patients in the Isthmus of Panama, and in from 20 to 30 per cent. of the patients in the insane division. When in large numbers they cause diarrhœa, but from his studies there Darling concludes that they are not the cause of severe diarrhœa, though they may produce moderate anæmia. The mother worm burrows in the mucous membrane and deposits ova. The parasite is found in the upper parts of the small intestines. They are met

with occasionally in the temperate regions. Three cases were reported from my clinic by Thayer.

Acanthocephala (*Thorn-headed Worms.*)—The *Gigantorhynchus* or *Echinorhynchus gigas* is a common parasite in the intestine of the hog and attains a large size. The larvæ develop in cockchafer grubs. The American intermediate host is the June bug (Stiles). Lambl found a small *Echinorhynchus* in the intestine of a boy. Welch's specimen, which was found encysted in the intestine of a soldier at Netley, is stated by Cobbold probably not to have been an *Echinorhynchus*. Recently a case of *Echinorhynchus moniliformis* has been described in Italy by Grassi and Calandruccio.

IV. PARASITIC ARACHNIDA AND TICKS

Pentastomes.—1. LINGUATULA RHINARIA (*Pentastoma tænioides*) has a somewhat lancet-shaped body, the female being from 3 to 4 inches in length, the male about an inch in length. The body is tapering and marked by numerous rings. The adult worm infests the frontal sinuses and nostrils of the dog, more rarely of the horse. The larval form, which is known as the *Linguatula serrata* (*Pentastomum denticulatum*), is seen in the internal organs, particularly the liver, but has also been found in the kidney. The adult worm has been found in the nostril of man, but is very rare and seldom occasions any inconvenience. The larvæ are by no means uncommon, particularly in parts of Germany. The parasite is very rare. Flint refers to a Missouri case in which from 75 to 100 of the parasites were expectorated. The liver was enlarged and the parasites probably occupied this region. In 1869 I saw a specimen which had been passed with the urine by a patient of James H. Richardson, of Toronto.

2. The POROCEPHALUS CONSTRICTUS (*Pentastomum constrictum*), has the length of half an inch, with twenty-three rings on the abdomen. It is found in the Congo district and in parts of Asia. The larvæ, found in cysts in the lungs and liver, cause disease as they wander. The adult form lives in the nasal cavities and lungs of pythons and other snakes and man is infected probably through the drinking water.

Demodex (Acarus) folliculorum (var. **hominis**).—A minute parasite, from 0.3 mm. to 0.4 mm. in length, which lives in the sebaceous follicles, particularly of the face. It is doubtful whether it produces any symptoms. Possibly when in large numbers they may excite inflammation of the follicles, leading to acne.

Sarcoptes (Acarus) scabiei (*Itch Insect*).—This is the most important of the arachnid parasites, as it produces troublesome and distressing skin eruptions. The male is 0.23 mm. in length and 0.19 mm. in breadth; the female is 0.45 mm. in length and 0.35 mm. in width. The female can be seen readily with the naked eye and has a pearly-white color. It is not so common a parasite in the United States and Canada as in Europe.

The insect lives in a small burrow, about 1 cm. in length, which it makes for itself in the epidermis. At the end of this burrow the female lives. The male is seldom found. The chief seat of the parasite is in the folds where the skin is most delicate, as in the web between the fingers and toes.

the backs of the hands, the axilla, and the front of the abdomen. The head and face are rarely involved. The lesions which result from the presence of the itch insect are very numerous and result largely from the irritation of the scratching. The commonest is a papular and vesicular rash, or, in children, an ecthymatous eruption. The irritation and pustulation which follow the scratching may completely destroy the burrows, but in typical cases there is rarely doubt as to the diagnosis.

The *treatment* is simple. It should consist of warm baths with a thorough use of a soft soap, after which the skin should be anointed with sulphur ointment, which in the case of children should be diluted. An ointment of naphthol (drachm to the ounce) is very efficacious.

Leptus autumnalis (*Harvest Bug*).—This reddish-colored parasite, about half a millimetre in size, is often found in large numbers in fields and in gardens. They attach themselves to animals and man with their sharp proboscides, and the hooklets of their legs produce a great deal of irritation. They are most frequently found on the legs. They are readily destroyed by sulphur ointment or corrosive-sublimate lotions.

Ixodiasis (*Tick-fever*).—In South Africa, particularly in the western provinces of the Uganda Protectorate, the western districts of German East Africa and the eastern regions of the Congo Free State, there is a disease known by this name, believed to be transmitted by a tick—the *Ornithodorus* or *Argas moubata*. Christy states that the bite of the *O. savignyi* does not produce any ill effects. The ticks live in old houses, and their habits are very much like those of the common bedbug. This tick transmits the *spirochæta duttoni*, the cause of the African form of relapsing fever, already mentioned.

The *Dermacentor occidentalis* is present in the Northwestern States from California to Montana. The bites may cause severe lymphangitis. It appears to be the medium of transmission of the Rocky Mountain spotted fever. In Arizona and other parts of the Southwestern States a tick—*Ornithodorus megnini*—is occasionally found in the ear and in the nose, causing suppuration and intense suffering.

Several other varieties of ticks are occasionally found on man—the *Ixodes ricinus* and the *Dermacentor americanus*, which are met with in horses and oxen.

V. PARASITIC INSECTS

Pediculi (*Phthiriasis; Pediculosis*).—There are three varieties: of the body louse, which are found only in persons of uncleanly habits.

PEDICULUS CAPITIS.—The male is from 1 to 1.5 mm. in length and the female nearly 2 mm. The color varies somewhat with the different races of men. It is light gray with a black margin in the European, and very much darker in the negro and Chinese. They are oviparous, and the female lays about sixty eggs, which mature in a week. The ova are attached to the hairs, and can be readily seen as white specks, known popularly as nits. The symptoms are irritation and itching of the scalp. When numerous, the insects may excite an eczema or a pustular dermatitis, which causes crusts and scabs, particularly at the back of the head. In the most extreme cases

the hair becomes tangled in these crusts and matted together, forming at the occiput a firm mass which is known as *plica polonica,* as it was not infrequent among the Jewish inhabitants of Poland.

Pediculus corporis (*vestimentorum*).—This is considerably larger than the head louse. It lives on the clothing, and in sucking the blood causes minute hæmorrhagic specks, which are very common about the neck, back, and abdomen. The irritation of the bites may cause urticaria, and the scratching is usually in linear lines. In long-standing cases, particularly in old dissipated characters, the skin becomes rough and greatly pigmented, a condition which has been termed the vagabond's disease—*morbus errorum* —and which may be mistaken for the bronzing of Addison's disease. The pigmentation ~~in some cases~~ may be extreme and extend to the face and buccal mucosa.

Phthirius pubis differs somewhat from the other forms. and is found in the parts of the body covered with short hairs, as the pubes; more rarely the axilla and eyebrows.

The *taches bleuâtres* or peliomata, excited by the irritation of pediculi, are peculiar subcuticular bluish or slate-colored spots from 5 to 10 mm. in diameter seen about the abdomen and thighs, particularly in febrile cases. They are very well pictured in Murchison's work on Fevers. The spots are more marked on white thin skins. They are stains caused by a pigment in the secretion of the salivary glands of the louse. I have never seen these *maculæ ceruleæ,* as they are also called, without finding the lice or their nits.

Treatment.—For the *Pediculus capitis,* when the condition is very bad, the hair should be cut short, as it is very difficult to destroy thoroughly all the nits. Repeated saturations of the hair in coal-oil or in turpentine are usually efficacious, or with lotions of carbolic acid, 1 to 50. Scrupulous cleanliness and care are sufficient to prevent recurrence. In the case of the *Pediculus corporis,* the clothing should be placed for hours in a disinfecting oven. To allay the itching a warm bath containing 4 or 5 ounces of bicarbonate of soda is useful. The skin may be rubbed with a lotion of carbolic acid, 2 drachms to the pint, with 2 ounces of glycerin. For the *Phthirius pubis* white precipitate or ordinary mercurial ointment should be used, and the parts should be thoroughly washed two or three times a day with soft soap and water.

Cimex lectularius (*Common Bedbug*).—The tropical and sub-tropical variety is *Cimex rotundalius* (W. S. Patton). It lives in the crevices of the bedstead and in the cracks in the floor and in the walls. It is nocturnal in its habits. The peculiar odor of the insect is caused by the secretion of a special gland. The parasite possesses a long proboscis, with which it sucks the blood. Individuals differ remarkably in the reaction to the bite of this insect; some are not disturbed in the slightest by them, in others the irritation causes hyperæmia and often intense urticaria. Fumigation with sulphur or scouring with corrosive-sublimate solution or kerosene destroys them. Iron bedsteads should be used.

Pulex irritans (*Common Flea*).—The male is from 2 to 2.5 mm. in length, the female from 3 to 4 mm. The flea is a transient parasite on man. The bite causes a circular red spot of hyperæmia in the centre of which is a little speck where the boring apparatus has entered. The amount

xylene (xylol or dimethyl benzene)

undiluted causes sharp burning sensation (inflammable)

xylene
alcohol
ether | equal part - a few drops

soak cotton in it apply to head. goose scalp a
draw hair through the plug

if black or eczema

xylene	44	apply twice a week.
Perchloride	30	

of irritation caused by the bite is variable. Many persons suffer intensely and a diffuse erythema or an irritable urticaria develops; others suffer no inconvenience whatever.

The *Pulex penetrans* (*sand-flea, jigger*) is found in tropical countries, particularly in the West Indies and South America. It is much smaller than the common flea, and not only penetrates the skin, but burrows and produces an inflammation with pustular or vesicular swelling. It most frequently attacks the feet. It is readily removed with a needle. Where they exist in large numbers the essential oils are used on the feet as a preventive.

VI. PARASITIC FLIES

(*Myiasis, Myiosis*)

The accidental invasion of the body cavities and of the skin by the larvæ of the diptera is known as myiasis.

The larvæ of the *Lucilia macellaria*, the so-called screw-worm, have been found in the nose, in wounds, and in the vagina after delivery. They can be removed readily with forceps; if there is any difficulty, thorough cleansing and the application of an antiseptic bandage are sufficient to kill them. The ova of the blue-bottle fly may be deposited in the nostrils, the ears, or the conjunctiva—the myiasis narium, aurium, conjunctivæ. This invasion rarely takes place unless these regions are the seat of disease. In the nose and in the ear the larvæ may cause serious inflammation. Even the urethra has not been spared in these dipterous invasions.

Gastro-intestinal myiasis may result from the swallowing of the larvæ of the common house-fly or of species of the genus *Anthomyia*. There are many cases on record in which the larvæ of the *Musca domestica* have been discharged by vomiting. Instances in which dipterous larvæ have been passed in the fæces are less common. Finlayson, of Glasgow, has reported an interesting case in a physician, who, after protracted constipation and pain in the back and sides, passed large numbers of the larvæ of the flower-fly—*Anthomyia canicularis*. Among other forms of larvæ or gentles, as they are sometimes called, which have been found in the fæces are those of the common house-fly, the blue-bottle fly, and the *Teichomyza fusca*. The larvæ of other insects are extremely rare. It is stated that the caterpillar of the taby moth has been found in the fæces.

A specimen of the *Homalomyia scalaris*, one of the privy flies, was sent to me by Dr. Hartin, of Kaslo City, British Columbia, the larvæ of which were passed in large numbers in the stools of a man aged twenty-four, a native of Louisiana. They were present in the stools from May 1 to July 15, 1897. There are cases in which the larvæ have been passed for years, in one instance 12 years!

Although no grave results necessarily follow the invasion of the alimentary tract by these larvæ, yet they may be the cause of serious intestinal ulceration manifesting itself by a dysenteric disease with fatal result. Cockayne, who has recently (1913) studied the question, states that there are four deaths on record.

Cutaneous Myiasis.—The most common form of cutaneous myiasis is that in which an external wound becomes "living," as it is called. This myiasis vulnerum is caused by the larvæ of either the blue-bottle or the common flesh-fly.

The skin may also be infected by the larvæ of the *Musca vomitoria*, but more commonly by the bot-flies of the ox and sheep which occasionally attack man. This condition is rare in temperate climates. Matas has described a case in which œstrus larvæ were found in the gluteal region. In parts of Central America the eggs of another bot-fly, the *Dermatobia*, are not infrequently deposited in the skin and produce a swelling very like the ordinary boil.

Dermamyiasis linearis migrans œstrosa is a remarkable cutaneous condition, observed particularly in Russia and occasionally in other countries, in which the larva of *Gastrophilus equi* (Samson), the horse bot-fly, makes a slightly raised pale red "line" which travels over the body surface, sometimes with great rapidity. It has been referred to as Larva migrans and as Creeping Eruption. (See Hamburger, Journal of Cutaneous Diseases, 1904.)

In Africa the larvæ of the Cayor fly are not uncommonly found beneath the skin in little boils. In the Congo region Dutton, Todd, and Christy found a troublesome blood-sucking dipterous larva, known as the floor maggot, the fly of which is the *Anchmeromyia luteola*.

Phlebotomous Fever.—In Herzegovina, Malta and Crete and other parts of the Mediterranean there is a fever of two or three days' duration, caused by the bite of the sand-fly, *Phlebotomus papatasii*. The manifestations are those of fever alone, and may be mistaken for abortive typhoid, febricula or mild Malta fever. The disease is known as pappataci fever and on the Dalmatian coast it is severe. The experiments of Doerr and of Birt show that the disease is readily caused by the bite of infected sand-flies.

Caterpillar Rash.—In some districts in Europe the hairs of the procession caterpillar, particularly of the species *Cnethocampa*, cause an intense urticaria, the so-called *U. epidemica*. There are districts in Switzerland which have been rendered uninhabitable in consequence of the skin rashes caused by the caterpillars. Of late years in New England and some other parts of the United States the caterpillar of the brown-tailed moth has caused much discomfort. The hairs are widely distributed by the wind, and the barbs are so arranged that they readily work into the skin. Whole families have been affected by an intense eruption which has been mistaken for that of small-pox. In England, Thresh has called attention to the frequency of these caterpillar rashes due to the yellow-tailed moth, *Porthesia similis*.

Harvest Rash (*Erythema Autumnale*).—In parts of England during the autumn many people are attacked by the harvest bug or harvesters, which may cause a very obstinate and distressing malady. Usually attributed to the harvest spider, it is in reality caused by a mite, parasitic upon it, the hexapod larva of the silky trombidian. It is so small as to be scarcely visible and is brick-red in color. They chiefly attack persons with delicate skins on the ankles and legs, but they may also attack the arms and the neck. The mite attaches itself to the skin by its claws, sucks the blood, and the swollen red abdomen may sometimes be seen as a bright-red dot. A papulo-vesicular, sometimes a pustular, eruption with an intolerable itching is

'Sawfly larva'?

caused by it. So intense may the eruption be, with perhaps an entire family attacked at once, that suspicion of poisoning may be aroused. The parasite is readily killed by benzine.

E. INFECTIOUS DISEASES OF DOUBTFUL OR UNKNOWN ETIOLOGY

I. SMALL-POX (Variola)

Definition.—An acute infectious disease characterized by a cutaneous eruption which passes through the stages of papule, vesicle, pustule, and crust.

History.—The existence of the disease in ancient Egypt is suggested by the eruption on the skin of a mummy of the 20th dynasty—1,200 to 1,100 B. C. (Rüffer and Ferguson). The disease existed in China many centuries before Christ. The *pesta magna* described by Galen (of which Marcus Aurelius died) is believed to have been small-pox. In the sixth century it prevailed, and subsequently, at the time of the Crusades, became widespread. It was brought to America by the Spaniards early in the sixteenth century. The first accurate account was given by Rhazes, an Arabian physician who lived in the ninth century, and whose admirable description is available in Greenhill's translation for the Sydenham Society. In the seventeenth century the illustrious Sydenham differentiated measles from small-pox. Special events in the history of the disease are the introduction of inoculation into Europe, by Lady Mary Wortley Montagu, in 1718, and the discovery of vaccination by Jenner, in 1796.

Etiology.—Small-pox is one of the most virulent of contagious diseases, and persons exposed, if unprotected by vaccination, are almost invariably attacked. Instances of natural immunity are rare. It is said that Diemerbroeck, a celebrated Utrecht professor in the seventeenth century, was not only himself exempt, but likewise many members of his family. One of the nurses in the small-pox department of the Montreal General Hospital stated that she had never been successfully vaccinated, and she certainly had no mark. An attack may not protect for life. There are undoubted cases of a second, reputed instances, indeed, of a third attack.

Age.—Small-pox is common at all ages, but is particularly fatal to young children. Of 3,164 deaths in the Montreal epidemic of 1885-'86, 2,717 were of children under ten years of age. The *fetus in utero* may be attacked, but only if the mother herself is the subject of the disease. The child may be born with the rash out or with the scars. In the case of twins, only one may be attacked; Kaltenbach records an instance of triplets, only two of which were affected (Comby). Children born in a small-pox hospital, if vaccinated immediately, may escape the disease; usually, however, they die early. (See Hunter's works, iv, p. 74.)

Sex.—Males and females are equally affected.

Race.—Among aboriginal races small-pox is terribly fatal. When the disease was first introduced into America the Mexicans died by thousands, and the North American Indians have also been frequently decimated by

this plague. It is stated that the negro is especially susceptible, and the mortality is greater—about 42 per cent. in the black, against 29 per cent. in the white (W. M. Welch).

It is claimed that isolation hospitals increase the incidence of the disease in a locality. J. Glaister, who has considered the whole question very carefully, concludes that as a centre of traffic such an institution, through the channels of unavoidable human intercourse, naturally favors the spread of the disease locally, but decides against the aerial conveyance of the disease, in spite of the very strong evidence.

The disease smoulders here and there and when conditions are favorable becomes epidemic. This was well illustrated by the celebrated Montreal outbreak of 1885. For several years there had been no small-pox in the city, and a large unprotected population grew up among the French-Canadians, many of whom were opposed to vaccination. On February 28 a Pullman-car conductor, who had traveled from Chicago, was admitted into the Hôtel-Dieu, the civic small-pox hospital being at the time closed. Isolation was not carried out, and on the 1st of April a servant in the hospital died of small-pox. Following her decease, the authorities of the hospital dismissed all patients presenting no symptoms of contagion who could go home. The disease spread like fire in dry grass, and within nine months 3,164 persons died in the city of small-pox.

Variations in the Virulence of Epidemics.—Sydenham states that "small-pox also has its peculiar kinds, which take one form during one series of years, and another during another"; and not only does what he called the epidemic constitution vary greatly, but one sometimes sees the most extraordinary variations in the intensity of the disease in members of a family all exposed to the same infection. A striking illustration of this variability has been given in the recent epidemics, which have been of so mild a character that in many localities it has been mistaken for chicken-pox; in others, particularly in the United States, the belief prevailed that a new disease had arisen, to which the name "Cuban itch" or "Philippine itch" has been given. Very often a correct diagnosis has not been reached until a fatal case has occurred. ~~As will be mentioned~~, A small outbreak occurred in one of my wards for colored patients, which we mistook at first for chicken-pox. The same peculiarities have been observed in the Leicester, Nottingham, and Cambridge outbreaks. Even in unvaccinated children the disease has been exceedingly mild. Some of the Leicester cases had only a few pocks (Allan Warner); but this is an old story in the history of the disease. John Mason Good, in commenting on this very point, refers to the great variability in the epidemics, and states that he himself as a child of six (1770) passed through small-pox with "scarcely any disturbance and not more than twenty scattered pustules"!

The disease described in some of the Brazilian states as Alastrin amas, or varioloid varicella, seen also in the West Indies, is probably a mild small-pox.

Recent Prevalence.—In the United States in 1909 there were 24,099 cases with 150 deaths; in 1910, 30,352 cases and 415 deaths. The mild type of the disease continues, but in places there have been virulent outbreaks. In England and Wales there were only ~~10~~ 13 deaths from the disease in 1910. 1915

newer figures, on page 321.

1915. Gut

Nature of Contagion.—Protozoön-like bodies were described in the skin lesions by Guarnieri—*the cytoryctes variolæ*. Councilman and his colleagues describe a protozoön with a double cycle and cytoplasmic stage, with small structureless bodies in the lower layer of the epithelial cells. The dried scales constitute by far the most important element, and as a dust-like powder are distributed everywhere in the room during convalescence, becoming attached to clothing and various articles of furniture. The disease is probably contagious from a very early stage, though I think it has not yet been determined whether the contagion is active before the eruption develops. The poison is of unusual tenacity and clings to infected localities. It is conveyed by persons who have been in contact with the sick and by fomites. During epidemics it is no doubt widely spread in street-cars and public conveyances. It must not be forgotten that an unprotected person may contract a very virulent form of the disease from the mild varioloid.

Morbid Anatomy.—The pustules may be seen upon the tongue and the buccal mucosa, and on the palate; sometimes also in the pharynx and the upper part of the œsophagus. In exceptionally rare cases the rash extends down the œsophagus and even into the stomach. Swelling of the Peyer's follicles is not uncommon; the pustules have been seen in the rectum.

In the larynx the eruption may be associated with a fibrinous exudate and sometimes with œdema. Occasionally the inflammation penetrates deeply and involves the cartilages. In the trachea and bronchi there may be ulcerative erosions, but true pocks, such as are seen on the skin, do not occur.

The heart occasionally shows myocardial changes, parenchymatous and fatty; endocarditis and pericarditis are uncommon. French writers have described an endarteritis of the coronary vessels. The spleen is markedly enlarged. Apart from the cloudy swelling and areas of coagulation-necrosis, lesions of the kidneys are not common. Nephritis may occur.

In the hæmorrhagic form extravasations are found on the serous and mucous surfaces, in the parenchyma of organs, in the connective tissues, about the nerve-sheaths and in the muscles. In one instance I found the entire retro-peritoneal tissue infiltrated with a large coagulum, and there were also extensive extravasations in the course of the thoracic aorta. Hæmorrhages in the bone-marrow have also been described. The spleen is firm and hard in hæmorrhagic small-pox, and such was the case in seven instances I examined. In these rapidly fatal forms the liver has been described as fatty, but in 5 of my 7 cases it was of normal size, dense, and firm.

Symptoms.—Three forms of small-pox are described:

(*a*) *Variola vera;* (1) Discrete, (2) Confluent.

(*b*) *Variola hæmorrhagica;* (1) Purpura variolosa or black small-pox; (2) Hæmorrhagic pustular form, variola hæmorrhagica pustulosa.

(*c*) *Varioloid,* or small-pox modified by vaccination.

(*a*) Variola Vera.—The affection may be conveniently described under various stages: *Incubation.*—"From nine to fifteen days; oftenest twelve." I have seen it as early as the eighth day after exposure, and there are well-authenticated instances in which this stage has been prolonged to twenty days. It is unusual for patients to complain of any symptoms.

Invasion.—In adults a chill and in children convulsions are common initial symptoms. There may be repeated chills within the first twenty-four

hours. Intense frontal headache, severe lumbar pains, and vomiting are very constant features. The pains in the back and in the limbs are more severe in the initial stage of this than of any other eruptive fever, and their combination with headache and vomiting is so suggestive that precautionary measures may often be taken several days before the eruption appears. The temperature rises quickly, and may on the first day be 103° or 104°. The pulse is rapid and full, not often dicrotic. In severe cases there may be marked delirium, particularly if the fever is high. The patient is restless and distressed, the face is flushed, and the eyes are bright and clear. The skin is usually dry, though occasionally there are profuse sweats. One cannot judge from the initial symptoms whether a case is likely to be discrete or confluent, as convulsions, severe headache, and high fever may precede a very mild attack.

Initial Rashes.—Two forms can be distinguished: the diffuse, scarlatinal, and the macular or measly form; either of which may be associated with petechiæ and occupy a variable extent of surface. In some instances they are

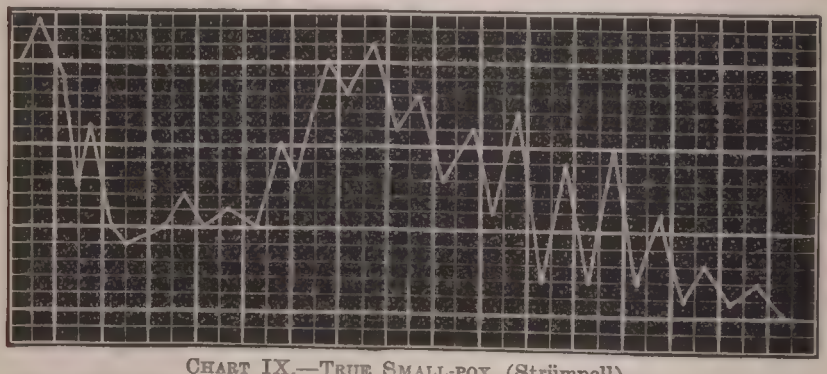

CHART IX.—TRUE SMALL-POX (Strümpell).

general, but as a rule they are limited either to the lower abdominal areas, to the inner surfaces of the thighs, and to the lateral thoracic region, or to the axillæ. Occasionally they are found over the extensor surfaces, particularly in the neighborhood of the knees and elbows. These rashes, usually purpuric, are often associated with an erythematous or erysipelatous blush. The scarlatinal rash may come out as early as the second day, and be as diffuse and vivid as in a true scarlatina. The measly rash may also be diffuse and resemble closely that of measles. Urticaria is only occasionally seen. It was present once in my Montreal cases. The initial rashes are more abundant in some epidemics than in others. They occur in from 10 to 16 per cent. of cases.

Eruption.—(1) In the *discrete form*, usually on the fourth day, macules appear on the forehead, preceded sometimes by an erythematous flush, and on the anterior surfaces of the wrists. Within the first twenty-four hours from their appearance they occur on other parts of the face and on the extremities, and a few are seen on the trunk. The spots are from 2–3 millimetres in diameter, of a bright red color, and disappear completely on pressure. As the rash comes out the temperature falls, the general symptoms subside, and the patient feels comfortable. On the fifth or sixth day the

papules change into vesicles with clear summits. Each one is elevated, circular, and presents a little depression or umbilication in the centre. About the eighth day the vesicles change into pustules, the umbilication disappears, the flat top assumes a globular form and becomes grayish-yellow in color, owing to the contained pus. There is an areola of injection about the pustules and the skin between them is swollen. This maturation first takes place on the face, and follows the order of the appearance of the eruption. The temperature now rises—secondary fever—and the general symptoms return. The swelling about the pustules is attended with a good deal of tension and pain in the face; the eyelids become swollen and closed. In the discrete form the temperature of maturation does not usually remain high for more than twenty-four or twenty-six hours, so that on the tenth or eleventh day the fever disappears and the stage of convalescence begins. The pustules rapidly dry, first on the face and then on the other parts, and by the fourteenth or fifteenth day desquamation may be far advanced on the face. The march and distribution of the rash are often most characteristic. The abdomen and groins and the legs are the parts least affected. The rash is often copious on the upper part of the back, scanty on the lower. Vesicles in the mouth, pharynx, and larynx cause soreness and swelling in these parts, with loss of voice. Whether pitting takes place depends a good deal upon the severity of the disease. In a majority of cases Sydenham's statement holds good, that "it is very rarely the case that the distinct small-pox leaves its mark." The odor of a small-pox patient is very distinctive even in the early stages, and I have known it to be a help in the diagnosis of a doubtful case.

(2) *The Confluent Form.*—With the same initial symptoms, though usually of greater severity, the rash appears on the fourth, or, according to Sydenham, on the third day. The more the eruption shows itself before the fourth day the more sure it is to become confluent (Sydenham). The papules at first may be isolated, and it is only later in the stage of maturation that the eruption is confluent. But in severer cases the skin is swollen and hyperæmic and the papules are very close together. On the feet and hands, too, the papules are thickly set; more scattered on the limbs; and quite discrete on the trunk. With the appearance of the eruption the symptoms subside and the fever remits, but not to the same extent as in the discrete form. Occasionally the temperature falls to normal and the patient may be very comfortable. Then, usually on the eighth day, the fever again rises, the vesicles change to pustules, the hyperæmia becomes intense, the swelling of the face and hands increases, and by the tenth day the pustules have fully maturated, many of them have coalesced, and the entire skin of the head and extremities is a superficial abscess. The fever rises to 103° or 105°, the pulse is from 110 to 120, and there is often delirium. As pointed out by Sydenham, salivation in adults and diarrhœa in children are common symptoms of this stage. There is usually much thirst. The eruption may also be present in the mouth, and usually the pharynx and larynx are involved and the voice is husky. Great swelling of the cervical lymphatic glands occurs. At this stage the patient presents a terrible picture, unequaled in any other disease and one which fully justifies the horror and fright with which small-pox is associated in the public mind. Even when the rash is confluent on the face, hands, and feet, the pustules remain discrete on the trunk. The danger, as pointed out

by Sydenham, is in proportion to the number upon the face. "If upon the face they are as thick as sand, it is no advantage to have them few and far between on the rest of the body." In fatal cases by the tenth or eleventh day the pulse gets feebler and more rapid, the delirium is marked, there is subsultus, sometimes diarrhœa, and with these symptoms the patient dies. In other instances between the eighth and eleventh day hæmorrhagic features occur. When recovery takes place, the patient enters on the eleventh or twelfth day the period of desiccation.

Desiccation.—The pustules break and the pus exudes or they dry and form crusts. Throughout the third week the desiccation proceeds and in cases of moderate severity the secondary fever subsides; but in others it may persist until the fourth week. The crusts in confluent small-pox adhere for a long time and the process of scarring may take three or four weeks. On the face they fall off singly, but the tough epidermis of the hands and feet may be shed entire.

(*b*) HÆMORRHAGIC SMALL-POX occurs in two forms. In one, the petechial or black small-pox—*purpura variolosa*—the special symptoms appear early and death follows in from two to six days. In the other form the case progresses as one of ordinary variola, and in the vesicular or pustular stage hæmorrhages take place into the pocks or from the mucous membranes—*variola hæmorrhagica pustulosa.*

Purpura variolosa is more common in some epidemics than in others. It is less frequent in children than in adults. Of 27 cases admitted to the small-pox department of the Montreal General Hospital there were 3 under ten years, 4 between fifteen and twenty, 9 between twenty and twenty-five, 7 between twenty-five and thirty-five, 3 between thirty-five and forty-five, and 1 above fifty. Young and vigorous persons seem more liable to this form. Several of my cases were above the average in muscular development. Men are more frequently affected than women; thus in my list there were 21 males and only 6 females. The influence of vaccination is shown in the fact that of the cases 14 were unvaccinated, while not one of the 13 who had scars had been revaccinated. The illness starts with the usual symptoms, but with more intense constitutional disturbance. On the evening of the second or on the third day there is a diffuse hyperæmic rash, particularly in the groins, with small punctiform hæmorrhages. The rash extends, becomes more distinctly hæmorrhagic, and the spots increase in size. Ecchymoses appear on the conjunctivæ, and as early as the third day there may be hæmorrhages from the mucous membranes. Death may take place before the papules appear. In this truly terrible affection the patient may present a frightful appearance. The skin may have a uniformly purplish hue and the unfortunate victim may even look plum-colored. The face is swollen and large conjunctival hæmorrhages with the deeply sunken corneæ give a ghastly appearance to the features. The mind may remain clear to the end. Death occurs from the third to the sixth day; thus in thirteen of my cases it took place between these dates. The earliest death was on the third day and there were no traces of papules. There may be no mucous hæmorrhages; thus in one case of a most virulent character death occurred without bleeding early on the fourth day. Hæmaturia is perhaps most common, next hæmatemesis, and melæna was noticed in a third of the cases. Metrorrhagia was present in one

It is really a mild form of the disease.

only of the six females on my list. Hæmoptysis occurred in five cases. The pulse in this form of small-pox is rapid and often hard and small. The respirations are greatly increased in frequency and out of all proportion to the intensity of the fever.

In *variola pustulosa hæmorrhagica* the disease progresses as a severe case, and the hæmorrhages do not occur until the vesicular or pustular stage. The first indication is hæmorrhage into the areolæ of the pocks, and later the maturated pustules fill with blood. The earlier the hæmorrhage the greater is the danger. Bleeding from the mucous membranes is also common in this form, and the great majority of the cases prove fatal, usually on the seventh, eighth, or ninth day, but a few cases recover. In patients with the discrete form, if allowed to get up early, hæmorrhage may take place into the pocks on the legs.

Leucocytes.—In variola vera there is a marked leucocytosis, 12–16 thousand, about the eighth day, then a slight decline and a rise again about the twelfth or fourteenth day, sometimes to 18,000 or 20,000. There is an increase in the mononuclear elements, which may be the only marked feature of the mild cases (Magrath, Brinckerhoff, and Bancroft).

(*c*) VARIOLOID.—This term is applied to the modified form which affects persons who have been vaccinated. It may set in with abruptness and severity, the temperature reaching 103°. More commonly it is in every respect milder in its initial symptoms, though the headache and backache may be very distressing. The papules appear on the evening of the third or on the fourth day. They are few in number and may be confined to the face and hands. The fever drops at once and the patient feels perfectly comfortable. The vesiculation and maturation of the pocks take place rapidly, and there is no secondary fever. There is rarely any scarring. As a rule, when small-pox attacks a person who has been vaccinated within five or six years the disease is mild, but it may prove severe, even fatal.

Abortive Types.—~~As already mentioned,~~ Recent epidemics have been characterized by the large number of mild cases. Even in unvaccinated children only a few pustules may appear, and the disease is over in a few days. Even with a thickly set eruption the vesicles at the fifth or sixth day, instead of filling, dry and abort, forming the so-called horn-, crystalline-, or wart-pox. *Variola sine eruptione* is described. I saw no cases of the kind in Montreal. They seem to have been not uncommon in the recent epidemics. Bancroft observed twelve cases in the Boston outbreak, all among physicians and attendants. The symptoms are headache, pain in the back, fever, and vomiting. As already mentioned, the pocks may be very scanty and easily overlooked, even in unvaccinated persons. One of Bancroft's cases was of special interest—a pregnant woman who had slight symptoms after exposure, but no rash. Her child showed a typical eruption when two days old.

Complications.—Considering the severity of many of the cases and the character of the disease, associated with multiple foci of suppuration, the complications in small-pox are remarkably few.

Laryngitis is serious in three ways: it may produce a fatal œdema of the glottis; it is liable to extend and involve the cartilages, producing necrosis; and by diminishing the sensibility of the larynx it may allow irritating particles to reach the lower air-passages, where they excite bronchitis or bronchopneumonia.

Broncho-pneumonia is almost invariably present in fatal cases. *Lobar pneumonia* is rare. *Pleurisy* is common in some epidemics.

The *cardiac* complications are also rare. In the height of the fever a systolic murmur at the apex is not uncommon; but endocarditis, either simple or malignant, is rarely met with. Pericarditis, too, is very uncommon. Myocarditis seems to be more frequent, and may be associated with endarteritis of the coronary vessels.

Of complications in the *digestive* system, parotitis is rare. In severe cases there is extensive pseudo-diphtheritic angina. Vomiting, which is so marked a symptom in the early stage, is rarely persistent. Diarrhœa is not uncommon, as noted by Sydenham, and particularly in children.

Albuminuria is frequent, but true *nephritis* is rare. Inflammation of the testes and of the ovaries may occur.

Among the most interesting and serious complications are those pertaining to the *nervous* system. In children convulsions are common. In adults the delirium of the early stage may persist and become violent, and finally subside into a fatal coma. Post-febrile insanity is occasionally met with during convalescence, and very rarely epilepsy. Many of the old writers spoke of paraplegia in connection with the intense backache of the early stage, but it is probably associated with the severe agonizing lumbar and crural pains and is not a true paraplegia. It must be distinguished from the form occurring in convalescence, which may be due to peripheral neuritis or to a diffuse myelitis (Westphal). The neuritis may, as in diphtheria, involve the pharynx alone, or it may be multiple. Of this nature, in all probability, is the so-called pseudo-tabes, or *ataxie variolique*. Hemiplegia and aphasia have been met with in a few instances, the result of encephalitis.

Among the most constant and troublesome complications are those involving the *skin*. During convalescence boils are very frequent and may be severe. Acne and ecthyma are also met with. Local gangrene in various parts may occur.

Arthritis may occur, usually in the period of desquamation, and may pass on to suppuration. Acute necrosis of the bone is sometimes met with.

A remarkable secondary eruption (recurrent small-pox) occasionally occurs after desquamation.

Special Senses.—The eye affections which were formerly so common and serious are not now so frequent, owing to the care which is given to keeping the conjunctivæ clean. A catarrhal and purulent conjunctivitis is common in severe cases. The secretions cause adhesions of the eyelids, and unless great care is taken a diffuse keratitis is excited, which may go on to ulceration and perforation. Iritis is not very uncommon. Otitis media is an occasional complication, and usually results from an extension of the disease through the Eustachian tubes.

Prognosis.—In unprotected persons small-pox is a very fatal disease, the death-rate ranging from 25 to 35 per cent. In Japan the mortality among unprotected persons has been even higher. In the recent mild epidemic in the United States the mortality has been very slight, e. g., for the five months ending November 24, 1911, 4,852 cases and 35 deaths. At the Municipal Hospital, Philadelphia, of 2,831 cases of variola, 1,534—i. e., 54.18 per cent.—died, while of 2,169 cases of varioloid only 28—i. e., 1.29 per cent.—died

Howard Beckwith - J.A.M.A. 1915. 65, 1188

Sensitized rabbits (by vacc. with vaccine virus
Give a second intradermal reaction with
smallpox vesicle extract in 24–48 hrs
— cutaneous allergy presented by smallpox

(W. M. Welch). Purpura variolosa is invariably fatal, and a majority of those attacked with the severer confluent forms die. The intemperate and debilitated succumb more readily to the disease. As Sydenham observed, the danger is directly proportionate to the intensity of the disease on the face and hands. "When the fever increases after the appearance of the pustules, it is a bad sign; but if it is lessened on their appearance, that is a good sign" (Rhazes). Very high fever, delirium and subsultus are symptoms of ill omen. The disease is particularly fatal in pregnant women and abortion usually takes place. It is not, however, uniformly so, and I have twice known severe cases to recover after miscarriage. Moreover, abortion is not inevitable. Very severe pharyngitis and laryngitis are fatal complications.

Death results in the early stage from the action of the poison upon the nervous system. In the later stages it usually occurs about the eleventh or twelfth day, at the height of the eruption. In children, and occasionally in adults, the laryngeal and pulmonary complications prove fatal.

Diagnosis.—During an epidemic the initial chill, the headache and backache, and the vomiting at once put the physician on his guard.

The initial rashes may lead to error. The scarlatinal rash has rarely the extent and never the persistence of the rash in true scarlet fever. I have known the rash of measles to be mistaken for the initial rash of small-pox. The general condition of the patient, and the presence of coryza, conjunctivitis and Koplik's sign, may be better guides than the rash itself.

Malignant hæmorrhagic small-pox may prove fatal before the characteristic rash appears. Of 27 cases of purpura variolosa, in only one, in which death occurred on the third day, did inspection fail to show the papules. In 3 cases dying on the fourth day the characteristic papular rash was noticed. It may be difficult or impossible to recognize this form of hæmorrhagic small-pox from *hæmorrhagic scarlet fever* or *hæmorrhagic measles*, though in the latter there is rarely so constant involvement of the mucous membranes.

Naturally enough, as they are allied affections, *varicella* is the disease which most frequently leads to error. Particularly has this been the case in the mild epidemic which has prevailed during the past three years. A negro patient was admitted to my wards on the fourth day of the disease. Small-pox was not prevalent at the time, and the case was regarded as one of varicella. Subsequently eight cases appeared, several of exceeding mildness, but our mistake was forcibly brought home to us by the occurrence, in a man who had been exposed in the ward, of a case of confluent small-pox of great severity. The following points are to be borne in mind: first, the experience of the past few years has shown that very mild epidemics of true small-pox may occur; secondly, any large number of cases of a contagious disease with a pustular eruption occurring in adults is strongly in favor of small-pox. The characters of the rash are of less value. Its abundance on the trunk in varicella is important. At the outset the papules have rarely the shotty, hard feel of small-pox. The vesicles are more superficial, the infiltrated areola is not so intense nor so constant, and as a rule the pocks may be seen in the same patient in all stages of development. The longer period of invasion, the prodromal rashes, the great intensity of the onset are also important points in small-pox. But, as I have said, there are mild epidemics in which it must be confessed that the recognition of the nature of the outbreak is sometimes

only confirmed by the appearance of a severe case of the confluent or ~~of the~~ hæmorrhagic form.

The disease may be mistaken for *cerebro-spinal fever*, in which purpuric symptoms are not uncommon. A four-year-old child was taken suddenly ill with fever, pains in the back and head, and on the second or third day petechiæ appeared on the skin. There were retraction of the head and marked rigidity of the limbs. The hæmorrhages became more abundant; and finally hæmatemesis occurred and the child died on the sixth day. At the post mortem there were no lesions of cerebro-spinal fever, and in the deeply hæmorrhagic skin the papules could be readily seen. The post mortem diagnosis of small-pox was ~~unhappily~~ confirmed by the mother taking the disease and dying of it.

Pustular Syphilides.—A very copious pustular rash in syphilis may resemble variola, particularly if accompanied by fever, but the history and the distribution, particularly the slight amount on the face, leave no question as to the diagnosis.

Pustular glanders has been mistaken for small-pox. In a remarkable instance of the kind in Montreal there was a widespread pustular eruption, which we thought at first was small-pox, but the subsequent course and the fact that there was glanders among the horses in the stable led to the correct diagnosis. The eruption resembled exactly that described in Rayer's monograph (De la Morve, 1837).

Impetigo contagiosa is stated to have been mistaken for variola.

Prophylaxis.—Thorough vaccination and re-vaccination are the most important preventive measures. All those exposed to infection should be vaccinated at once, as four days after exposure a successful vaccination may protect from the disease. During epidemics general vaccination of the community should be done and special care taken to recognize mild cases. Those who have been exposed should be isolated for sixteen days. Isolation of those with the disease should be rigid and, if possible, they should be placed in a special hospital. The attendants should wear gowns and caps; rubber gloves are an advantage. The linen should be placed in carbolic acid solution (2 per cent.) and boiled afterwards. Dressings should be burned. The patient should not be discharged until all the crusts are removed; a thorough sponging with carbolic solution (2 per cent.) is advisable.

Treatment.—General Considerations.—Segregation in special hospitals is imperative. In the case of local outbreaks temporary barracks or tents may be constructed.

We have no specific treatment. There should be abundance of fresh air; the diet should be liquid and large amounts of water and cold drinks given. A calomel and saline purge is advisable at the onset and later the bowels should be kept open by salines. ~~With severe toxæmia alcohol should be given.~~

In the early stages two symptoms call for treatment: the pain in the back, which, if not relieved by phenacetine (gr. v, 0.3 gm.), requires opium in some form, as advised by Sydenham; and the vomiting, which is very difficult to check and may be uncontrollable. Nothing should be given except a little ice and champagne, and it usually stops with the appearance of the eruption.

For the fever, cold sponging or the tub bath may be used; when there is

Phenol (3-5%) ist ist in Vaseline

much delirium with high fever the latter or the cold pack is preferable. In some cases, particularly with severe toxæmia and marked eruption, the continuous warm bath is advisable.

The treatment of the *eruption* is important. After trying all sorts of remedies, such as puncturing the pustules with nitrate of silver, or treating them with iodine and various ointments, I came to Sydenham's conclusion that in guarding the face against being disfigured by the scars "the only effect of oils, liniments, and the like was to make the white scurfs slower in coming off." The constant application on the face and hands of lint soaked in cold water, to which antiseptics such as carbolic acid (2 per cent.) or bichloride of mercury (1 to 5,000) may be added, is perhaps the most suitable local treatment. It is very pleasant to the patient, and for the face it is well to make a mask of lint, which can then be covered with oiled silk. When the crusts begin to form, the chief point is to keep them thoroughly moist, which may be done with oil or glycerin. This prevents the desiccation and diffusion of the flakes of epidermis. Vaseline is particularly useful, and at this stage may be freely used upon the face. It also relieves the itching. For the odor, which is sometimes so characteristic and disagreeable, the dilute carbolic solutions are probably best. If the eruption is abundant on the scalp, the hair should be cut short to prevent matting and decomposition of the crusts. When suppuration is marked the continuous warm bath (95°) is useful. Boric acid, alum or potassium permanganate may be added to the water.

The papules do not maturate so well when protected from the light, and for centuries attempts have been made to modify the course of the pustules by either excluding the light or by changing its character. In the Middle Ages John of Gaddesden recommended wrapping the patient in red flannel, and treated in this way the son of Edward I. It was an old practice of the Egyptians and Arabians to cover the exposed parts of small-pox patients with gold-leaf. Lutzenberg, a distinguished New Orleans physician, in 1832 treated patients by exclusion of the sunlight. Recently the red-light treatment of the disease has been advocated by Finsen. The statements do not agree as to its value. Nash states that the course of the rash may be modified by the treatment, but Ricketts and Byles could see no influence whatever, even in cases taken at the earliest possible date.

Complications.—If the diarrhœa is severe in children, paregoric may be given. When the pulse becomes feeble and rapid, stimulants may be freely given. The maniacal delirium may require chloroform or morphia, but for less intense nervous symptoms the bath or cold pack is the best. For the severe hæmorrhages of the malignant cases nothing can be done, and it is only cruel to drench the unfortunate patient with iron, ergot, and other drugs. Symptoms of obstruction in the larynx, usually from œdema, may call for tracheotomy. In the late stages of the disease, should the patient be extremely debilitated and the subject of abscesses and bed-sores, he may be placed on a water-bed or treated in the continuous warm bath.

The care of the eyes is most important. The lids should be thoroughly cleansed and the conjunctivæ washed with a warm solution of salt or boracic acid. In the confluent cases the eyelids are much swollen and glued together, and it is only constant watchfulness which prevents keratitis. The edges of

the lids should be smeared with vaseline. The mouth and throat should be kept clean, a potassium permanganate or carbolic mouth wash and gargle used, and the treatment of the nose with glycerin or sweet oil should be begun early, as it prevents the formation of hard crusts. Douching the nose with a warm alkaline solution is helpful.

The treatment in the stage of convalescence is important. Frequent bathing helps to soften the crusts, and the skin may be oiled daily. Convalescence should not be considered established until the skin is perfectly smooth and clean and free from any trace of scabs.

II. VACCINIA (Cow-pox)—VACCINATION

Definition.—An eruptive disease of the cow, the virus of which, inoculated into man (vaccination), produces a local pock with constitutional disturbance, which affords protection, more or less permanent, against small-pox.

The vaccine is got either directly from the calf—animal lymph—in which the disease is propagated at regular stations, or is obtained from persons vaccinated (humanized lymph).

History.—For centuries it had been a popular belief among farmer folk that cow-pox protected against small-pox. The notorious Duchess of Cleveland, replying to some joker who suggested that she would lose her occupation if she was disfigured with small-pox, said that she was not afraid of the disease, as she had had a disease that protected her against small-pox. Jesty, a Dorsetshire farmer, had had cow-pox, and in 1774 vaccinated successfully his wife and two sons. Plett, in Holstein, in 1791, also successfully vaccinated three children. When Jenner was a student at Sodbury, a young girl, who came for advice, when small-pox was mentioned, exclaimed, "I cannot take that disease, for I have had cow-pox." Jenner subsequently mentioned the subject to Hunter, who in reply gave the famous advice: "Do not think, but try; be patient, be accurate." As early as 1780 the idea of the protective power of vaccination was firmly impressed on Jenner's mind. The problem which occupied his attention for many years was brought to a practical issue when, on May 14, 1796, he took matter from the hand of a dairy-maid, Sarah Nelmes, who had cow-pox, and inoculated a boy named James Phipps, aged eight years. On July 1st, matter was taken from a small-pox pustule and inserted into the boy, but no disease followed. In 1798 appeared An Inquiry into the Causes and Effects of the Variola Vaccinæ, a Disease discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the Name of Cow-pox (pp. iv, 75, four plates, 4to. London, 1798).

In the United States cow-pox was introduced by Benjamin Waterhouse, Professor of Physic at Harvard, who on July 8, 1800, vaccinated seven of his children. In Boston on August 16, 1802, nineteen boys were inoculated with the cow-pox. On November 9th twelve of them were inoculated with small-pox; nothing followed. A control experiment was made by inoculating two unvaccinated boys with the same small-pox virus; both took the disease. The nineteen children of August 16th were again unsuccessfully inoculated with fresh virus from these two boys. This is one of the most crucial experiments in the history of vaccination, and fully justified the conclusion of the Board of Health—*cow-pox is a complete security against the small-pox.*

Practitioners should familiarize themselves with the literature on vaccination. The centenary number of the British Medical Journal is particularly valuable (1896). The report of the Royal Commission on vaccination (1897), the exhaustive articles in Allbutt and Rolleston's System by T. D. Acland, Copeman and McVail, and Cory's monograph on the subject afford a large body of material. To the public health officials who wish for distribution in handy shape Facts about Small-pox and Vaccination leaflets issued by the British Medical Association will be of the greatest value. The *Vaccination Law* of the German Empire, printed in English (Berlin, B. Paul, 1904), contains important information and statistics.

Nature of Vaccinia.—Is cow-pox a separate independent disease, or is it only small-pox modified by passing through the cow? In spite of a host of observations, this question is not yet settled. The experiments may be divided into two groups. First, those in which the inoculation of the small-pox matter in the heifer produced pocks corresponding in all respects to the vaccine vesicles. Lymph from the first calf inoculated into a second or third produced the characteristic lesions of cow-pox, and from the first, second, or third animal lymph used to vaccinate a child produced a typical localized vaccine vesicle without any of the generalized features of small-pox. The experiments of Ceely, of Babcock, and many other workers seem to leave no question whatever that typical vaccinia may be produced in the calf by the inoculation of variolous matter. A great deal of the vaccine material at one time in use in England was obtained in this way. Secondly, against this are urged Chauveau's Lyons experiments. Seventeen young animals were inoculated with the virus of small-pox. Small reddish papules occurred which disappeared rapidly, but the animals did not acquire cow-pox. Fifteen of the seventeen animals were also vaccinated. Of these only one showed a typical cow-pox eruption. To determine the nature of the original papules one was excised and inoculated into a non-vaccinated child, which developed as a result generalized confluent small-pox. A second child inoculated from the primary pustule of the first child developed discrete small-pox. The French still hold to the Lyons experiments as demonstrating the duality of the diseases.

The weight of evidence favors the view that cow-pox and horse-pox are variola modified by transmission; or, as has been suggested, "small-pox and vaccinia are both of them descended from a common stock—from an ancestor, for instance—which resembled vaccinia far more than it resembled small-pox" (Copeman).

The bodies described by Guarnieri have been very thoroughly studied by Councilman and his colleagues, who regard them as forms of a protozoön—*Cytoryctes vaccinia*—with a well-characterized development cycle, increasing in size until they undergo segmentation.

Normal Vaccination.—Period of Incubation.—At first there may be a little irritation at the site of inoculation, which subsides.

Period of Eruption.—On the third day, as a rule, a papule is seen surrounded by a reddish zone. This gradually increases, and on the fifth or sixth day shows a definite vesicle, the margins of which are raised while the centre is depressed. By the eighth day the vesicle has attained its maximum size. It is round and distended with a limpid fluid, the margin hard and

prominent, and the umbilication is more distinct. By the tenth day the vesicle is still large and is surrounded by an extensive areola. The contents have now become purulent. The skin is also swollen, indurated, and often painful. On the eleventh or twelfth day the hyperæmia diminishes, the lymph becomes more opaque and begins to dry. By the end of the second week the vesicle is converted into a brownish scab, which gradually becomes dry and hard, and in about a week (that is, about the twenty-first or twenty-fifth day from the vaccination) separates and leaves a circular pitted scar. If the points of inoculation have been close together, the vesicles fuse and may form a large combined vesicle. Constitutional symptoms of a more or less marked degree follow the vaccination. Usually on the third or fourth day the temperature rises, and may persist, increasing until the eighth or ninth day. There is a marked leucocytosis. In children it is common to have with the fever restlessness, particularly at night, and irritability; but as a rule these symptoms are trivial. If the inoculation is made on the arm, the axillary glands become large and sore; if on the leg, the inguinal glands. Immunity is not necessarily complete at once after vaccination; it may take as long as three weeks; on the other hand, a person exposed to small-pox and successfully vaccinated at once may escape entirely, or the two diseases may run concurrently, with the small-pox much modified. The duration of the immunity is extremely variable, differing in different individuals. In some instances it is permanent, but a majority of persons within ten or twelve years again become susceptible.

Revaccination should be performed between the tenth and fifteenth year, and whenever small-pox is epidemic. The susceptibility to revaccination is very general. In 1891–'92 vaccination pustules developed in 88.7 per cent. of the newly enrolled troops of the German army, most of whom had been vaccinated twice in their lives before. The vesicle in revaccination is usually smaller, has less induration and hyperæmia, and the resulting scar is less perfect. Particular care should be taken to watch the vesicle of revaccination, as it not infrequently happens that a spurious pock is formed, which reaches its height early and dries to a scab by the eighth or ninth day.

Irregular Vaccination.—(*a*) Local Variations.—We occasionally meet with instances in which the vesicle develops rapidly with much itching, has not the characteristic flattened appearance, the lymph early becomes opaque, and the crust forms by the seventh or eighth day. The evolution of the pocks may be abnormally slow. In such cases the operation should again be performed with fresh lymph. The contents of the vesicles may be watery and bloody. In the involution the bruising or irritation of the pocks may lead to ulceration and inflammation. A very rare event is the recurrence of the pock in the same place. Sutton reports four such recurrences within six months.

(*b*) Generalized Vaccinia.—It is not uncommon to see vesicles in the vicinity of the primary sore. Less common is a true generalized pustular rash, developing in different parts of the body, often beginning about the wrists and on the back. The secondary pocks may continue to make their appearance for five or six weeks after vaccination. In children the disease may prove fatal. They may be most abundant on the vaccinated limb, and occur usually about the eighth to the tenth day.

(*c*) Complications.—In unhealthy subjects, or as a result of uncleanli-

ness, or sometimes injury, the vesicles inflame and deep excavated ulcers result. Sloughing and deep cellulitis may follow. In debilitated children there may be with this a purpuric rash. Acland thus arranges the dates at which the possible eruptions and complications may be looked for:

1. During the first three days: Erythema; urticaria; vesicular and bullous eruptions; invaccinated erysipelas.

2. After the third day and until the pock reaches maturity: Urticaria; lichen urticatus, erythema multiforme; accidental erysipelas.

3. About the end of the first week: Generalized vaccinia; impetigo; vaccinal ulceration; glandular abscess; septic infections; gangrene.

4. After the involution of the pocks: Invaccinated diseases, ~~for example, syphilis.~~

(*d*) Transmission of Diseases by Vaccination.—Syphilis has undoubtedly been transmitted by vaccination, but such instances are very rare, and a large number of the cases of alleged vaccino-syphilis must be thrown out. The question has now become really of ~~minor~~ importance since the widespread use of animal lymph. Dr. Cory's sad experiment may here be referred to. He vaccinated himself four times from syphilitic children. With the first vaccination followed, but no syphilis. Two other attempts (negative) were made. The fourth time he was vaccinated from a child the subject of congenital syphilis. The lymph was taken from the child's arm with care, avoiding any contamination with blood. At two of the points of insertion red papules appeared on the twenty-first day. On the thirty-eight day a little ulcer was found, which Sir Jonathan Hutchinson decided was syphilitic. The diseased parts were then removed. By the fiftieth day the constitutional symptoms were well marked.

Among the differences between vaccino-syphilis and vaccination ulcers the most important is perhaps that the chancre never appears before the fifteenth day, usually not until from three to five weeks, whereas the ulceration of ordinary vaccination is present by the twelfth or fifteenth day. The loss of substance in the chancre is usually quite superficial and the induration very parchment-like and specific, with but a slight inflammatory areola. The glandular swelling, too, is constant and indolent, while in the vaccination ulcer it is often absent, or, when present, chiefly inflammatory.

Tuberculosis.—"No undoubted case of invaccinated tubercle was brought before the Royal Commission on Vaccination" (Acland). The risk of transmitting tuberculosis from the calf is so slight that it need not be considered. The transmission of leprosy by vaccination is doubtful.

The observations on the presence of actinomyces in vaccine virus have been confirmed by W. T. Howard, Jr., who found it 24 times in 95 cultures from the virus of five producers in the United States.

Tetanus.—McFarland collected 95 cases, practically all American. Sixty-three occurred in 1901, a majority of which could be traced to one source of supply, in which R. W. Wilson demonstrated the tetanus bacillus. Most of the cases occurred about Philadelphia. Since that date very few cases have been reported. The occurrence of this ~~terrible~~ complication emphasizes the necessity of the most scrupulous care in the preparation of the animal virus, as the tetanus bacillus is almost constantly present in the intestines of cattle.

(*e*) Influence of Vaccination upon Other Diseases.—A quiescent malady may be lighted into activity by vaccination. This has happened with congenital syphilis, occasionally with tuberculosis. An old idea was prevalent that vaccination had a beneficial influence upon existing diseases. Thomas Archer, the first medical graduate in the United States, recommended it in whooping-cough, and said that it had cured six or eight cases in his hands. At the height of the vaccination convulsions may occur and be followed by hemiplegia.

Technique.—That part of the arm about the insertion of the deltoid is usually selected for the operation. Mothers "in society" prefer to have girl babies vaccinated on the leg. The skin should be cleansed and put upon the stretch. Then, with a scalpel, needle, or the ivory point, cross-scratches or superficial incisions should be made in one or more places. Four points of insertion, an inch apart, are best. When glycerin lymph is used the drops may be placed on the skin first and the incisions then made. When the lymph has dried on the points it is best to moisten it in warm water. The clothing of the child should not be adjusted until the spot has dried, and it should be protected for a day or two with lint or a soft handkerchief. When the vesicle forms it can be protected by sterile gauze held in place by strapping. If erysipelas is prevalent, or if there are cases of suppuration in the same house, it is well to apply a pad of antiseptic cotton. Vaccination is usually performed between the fourth and sixth month. If unsuccessful, it should be repeated from time to time. It should be postponed if the child has any ailment or suffers from syphilis or a skin disease. Revaccination should be done at the age of nine years. A person exposed to the contagion of small-pox should always be revaccinated. This, if successful, will usually protect; but not always. The cases in which small-pox is taken within a few years after vaccination are probably instances of spurious vaccination.

The Value of Vaccination.—Sanitation cannot account for the diminution in small-pox and for the low rate of mortality. Isolation, of course, is a useful auxiliary, but it is no substitute. Vaccination is not claimed to be an invariable and permanent preventive of small-pox, but in an immense majority of cases successful inoculation renders the person for many years insusceptible. Communities in which vaccination and revaccination are thoroughly and systematically carried out are those in which small-pox has the fewest victims. The German army since 1874, the date of the stringent laws, has enjoyed practical immunity. On the other hand, communities in which vaccination and revaccination are persistently neglected are those in which epidemics are most prevalent. Owing to a widespread prejudice against vaccination in Montreal, there grew up, between the years 1876 and 1884, a considerable unprotected population, and the materials were ripe for an extensive epidemic. The soil had been prepared with the greatest care, and it only needed the introduction of the seed, which in due time came with the Pullman-car conductor from Chicago, on the 28th of February, 1885. Within the next ten months thousands of persons were stricken with the disease, and 3,161 died. The statistics from Japan, published by Kitasato (1911), show strikingly the efficacy of vaccination in that country. In the Japanese army of more than a million men in a war waged in a country in which small-pox was then endemic there were only 362 cases and 35 deaths. He shows with great

clearness the gradual lessening of the intensity of the epidemics in Japan as the system of vaccination has been perfected.

Although the effects of a single vaccination may wear out, as we say, and the individual again become susceptible to small-pox, yet the mortality in such cases is very much lower than in persons who have never been vaccinated. The mortality in persons who have been vaccinated is from 6 to 8 per cent., whereas in the unvaccinated it is at least 35 per cent. There is evidence that the greater the number of marks the greater the protection in relation to small-pox; thus, the English Vaccination Report states that out of 4,754 cases the death-rate with one mark was 7.6 per cent.; with two marks, 7 per cent.; with three marks, 4.2 per cent.; with four marks, 2.4 per cent. W. M. Welch's statistics of 5,000 cases on this point give with good cicatrices 8 per cent.; with fair cicatrices, 14 per cent.; with poor cicatrices, 27 per cent.; post-vaccinal cases, 16 per cent.; unvaccinated cases, 58 per cent.

III. VARICELLA (Chicken-pox)

Definition.—An acute contagious disease, characterized by an eruption of vesicles on the skin.

History.—Ingrassias, a distinguished Neapolitan professor, first recognized the disease as differing from small-pox (1553). Heberden gave it the name chicken-pox (1767).

Etiology.—The disease occurs in epidemics, but sporadic cases are also met with. It may prevail at the same time as small-pox or may follow or precede epidemics of this disease. It is a disease of childhood; a majority of the cases occur between the second and sixth years. Adults who have not had the disease in childhood are very liable to be attacked. The specific germ has not yet been discovered.

Varicella is an affection distinct from variola and without at present any relation whatever to it. An attack of the one does not confer immunity from an attack of the other. A boy, aged five, was admitted to St. Thomas' Hospital with a vesicular eruption, and was isolated in a ward on the same floor as the small-pox ward. The disease was pronounced chicken-pox, however, by Risdon Bennett and Bristowe. The patient was then removed and vaccinated, with a result of four vesicles which ran a pretty normal course. On the eighth day from the vaccination the child became feverish. On the following day the papules appeared and the child had a well-developed attack of small-pox with secondary fever (Sharkey).

Symptoms.—After a period of incubation of ten or fifteen days the child becomes feverish and in some instances has a slight chill. There may be vomiting, and pains in the back and legs. Convulsions are rare. The eruption usually occurs within twenty-four hours. It is first seen upon the trunk, either on the back or on the chest. It may begin on the forehead and face. At first in the form of raised red papules, these are in a few hours transformed into hemispherical vesicles containing a clear or turbid fluid. As a rule there is no umbilication, but in rare instances the pocks are flattened, and a few may even be umbilicated. They are often ovoid in shape and look more superficial than the variolous vesicles. The skin in the neighborhood

is not often infiltrated or hyperæmic. At the end of thirty-six or forty-eight hours the contents of the vesicles are purulent. They begin to shrivel, and during the third and fourth days are converted into dark brownish crusts, which fall off and as a rule leave no scar. Fresh crops appear during the first two or three days of the illness, so that on the fourth day one can usually see pocks in all stages of development and decay. They are always discrete, and the number may vary from eight or ten to several hundreds. As in variola, a scarlatinal rash occasionally precedes the development of the eruption. The eruption may occur on the mucous membrane of the mouth, and occasionally in the larynx. In adults the disease may be much more severe, the initial fever high, the rash very widespread, and the constitutional symptoms comparatively severe, so that the diagnosis of variola may be made—the so-called varicella variolaformes. The fever in varicella is slight, but it does not as a rule disappear with the appearance of the rash. The course of the disease is in a large majority of the cases favorable, and no ill effects follow. The disease may recur in the same individual. There are instances in which a person has had three attacks.

There are one or two modifications of the rash which are interesting. The vesicles may become very large and develop into regular bullæ, looking not unlike ecthyma or pemphigus (varicella bullosa). The irritation of the rash may be excessive, and if the child scratches the pocks ulcerating sores may form, which on healing leave ugly scars. Indeed, cicatrices after chicken-pox are more common than after varioloid.

In delicate children, particularly the tuberculous, gangrene (varicella escharotica) may occur about the vesicles, or in other parts, as the scrotum.

Cases have been described of hæmorrhagic varicella with cutaneous ecchymoses and bleeding from the mucous membranes.

Nephritis may occur. Infantile hemiplegia has occurred during an attack of the disease. Death has followed in an uncomplicated case from extensive involvement of the skin.

Diagnosis.—The diagnosis is as a rule easy, particularly if the patient has been seen from the onset. When a case comes under observation for the first time with the rash well out, there may be considerable difficulty. The abundance of the rash on the trunk in varicella is most important. The pocks in varicella are more superficial, more bleb-like, have not so deeply an infiltrated areola about them, and may usually be seen in all stages of development. They rarely at the outset have the hard, shotty feeling of those of small-pox. The general symptoms, the greater intensity of the onset, the prolonged period of invasion, and the more frequent occurrence of prodromal rashes in small-pox are important points in the diagnosis.

Death is very rare, and, unless from the complications, raises a suspicion of the correctness of the diagnosis. Thus of the 116 deaths in England and Wales in 1903 ascribed to chicken-pox, it is probable, as Tatham suggests, that many of these were from unrecognized small-pox.

No special *treatment* is required. If the rash is abundant on the face, great care should be taken to prevent the child from scratching the pustules. A soothing lotion should be applied on lint.

Arch. f. Path. 1915 32 641 720

Über Vaccinebildung durch Vaccine-Partikel. - Leonard Findlay

Only 690 in plan of 7590 in archive,

in plan 13-5901 in Vaccine.

1915. 2406 deaths.

IV. SCARLET FEVER

Definition.—An infectious disease characterized by a diffuse exanthem and an angina of variable intensity.

History.—In the sixteenth century Ingrassias of Naples and Coyttarus of Poitiers recognized the disease; but Sydenham in 1675 gave a full account of it under the name febris scarlatina.

Etiology.—No one of the acute infections varies so greatly in the intensity of the outbreaks, a point to which both Sydenham and Bretonneau called attention. In some years it is mild; in others, with equally widespread epidemics, it is fearfully malignant. It is a widespread affection, occurring in nearly all parts of the globe and attacking all races.

Sporadic cases occur from time to time. The epidemics are most intense in the autumn and winter. There is an extraordinary variability in the severity of the outbreaks, which on the whole appear to be lessening in severity; thus, in Boston from 1894 to 1903 the ratio of cases per ten thousand has ranged from 45.80 to 16.18, and the mortality from 3.94 to .60. In England and Wales the disease is declining. In 1883 there were over 12,000 deaths, in 1903, 4,158, in 1909, 3,215, and in 1910 ~~it was 50 per cent. less than in 1901~~. Newsholme attributes this in part to the general improvement in sanitation in the home and to hospital isolation, and in part to the ~~striking~~ decline in the severity of the disease.

Seibert's studies in New York show that the disease increases steadily from week to week until the middle of May; the frequency diminishes gradually until the end of June, and gradually increases through October, November, and December. He associates the remarkable drop in July, August, and September with the closure of the schools and the cessation of the daily congregation of infectious material in small areas—school-houses and playgrounds—for so many hours each day.

Age is the most important predisposing factor. Ninety per cent. of the fatal cases are under the tenth year. Sucklings are rarely attacked. The general liability to the disease in childhood is less widespread than in measles. Many escape in childhood; others escape until adult life; some never take it.

Family susceptibility is not infrequently illustrated by the death in rapid succession of four or five members. On the other hand, individual resistance is common, and many physicians constantly exposed escape. An attack as a rule confers subsequent immunity. In rare instances there have been one or even two recurrences.

The natives of India are said to enjoy comparative immunity.

Infectivity.—It is not yet accurately known where in the body the poison is formed. It is probably given off with the secretions of the nose, throat, and respiratory tract. The mild angina of the ambulatory cases may convey the disease, and in this way it is spread in schools, and the "return cases" may find in this way their explanation. ~~Much~~ More attention has been paid of late to this aspect of the scarlatinal infection, and it has ~~even~~ been suggested that the skin is only infective by contamination with the secretions. The general opinion, however, is that the poison is given off chiefly from the skin, particularly when desquamating. Unlike measles, the germ is very resistant

and clings tenaciously to clothing, to bedding, the furniture of the room, etc. Even after the most complete disinfection, possible, children who have been removed from an infected house may catch the disease on their return. The possibility here of throat and nose infection must be considered. The intractable character of the nasal discharge after scarlet fever is well recognized and this secretion appears to be highly infectious. The chief organisms in it are streptococci. A third person may convey the disease, but undoubted instances are rare. I recall one instance in which I could have been the only possible medium.

The disease is stated to have been conveyed by milk. Of 99 epidemics studied by Kober the disease prevailed in 68 either at the dairy or the milk farm. There appear to be two groups of cases: first, genuine scarlet fever, in which the infection is conveyed through the milk having come in contact with infected persons; and, secondly, outbreaks of an infection resembling scarlet fever, due to disease of the udder of the cows.

By SURGICAL SCARLATINA, first brought to the attention of the profession by Sir James Paget in 1864, is understood an erythematous eruption following an operation or occurring during septic infection. It differs from medical scarlatina in the large number of adults attacked, the shorter incubation, the mildness of the throat symptoms, the starting of the eruption at the wound, and the precocious desquamation. Alice Hamilton, after analyzing 174 cases reported in the literature, concludes that the eruption is most frequently due to septic infection and is not truly scarlatinal, and that in those cases in which the disease was undoubtedly scarlatina there is no convincing evidence that the relation between the wound and the scarlet fever was anything more than one of coincidence.

The SPECIFIC GERM is not known. It is claimed to be only a modified streptococcus infection. The streptococcus pyogenes has often been found in the blood during life and after death, and it is constantly present in the throat in severe cases; but there is no agreement on the subject among the best workers.

Morbid Anatomy.—Except in the hæmorrhagic form, the skin after death shows no traces of the rash. There are no specific lesions. Those which occur in the internal organs are due partly to the fever and partly to infection with pus-organisms.

The anatomical changes in the throat are those of simple inflammation, follicular tonsillitis, and, in extreme grades, of diphtheroid angina. In severe cases there are intense lymphadenitis and much inflammatory œdema of the tissues of the neck, which may go on to suppuration, or even to gangrene. Streptococci are found abundantly in the glands and in the foci of suppuration. The lymph glands and the lymphoid tissue may show hyperplasia and the spleen, liver, and other organs may be the seat of widespread focal necroses.

Endocarditis and pericarditis are not infrequent. Myocardial changes are less common. The renal changes will be considered with the diseases of the kidney.

Affections of the respiratory organs are not frequent. When death results from the pseudo-membranous angina, broncho-pneumonia is not uncommon. Cerebro-spinal changes are rare.

Symptoms.—INCUBATION.—"From one to seven days, oftenest two to four."

INVASION.—The onset is as a rule sudden. It may be preceded by a slight, scarcely noticeable, indisposition. An actual chill is rare. Vomiting is one of the most constant initial symptoms; convulsions are common. The fever is intense; rising rapidly, it may on the first day reach 104° or even 105°. The skin is unusually dry and to the touch gives a sensation of very pungent heat. The tongue is furred, and as early as the first day there may be complaint of dryness of the throat. Cough and catarrhal symptoms are uncommon. The face is often flushed and the patient has all the objective features of an acute fever.

ERUPTION.—Usually on the second day, in some instances within the first twenty-four hours, the rash appears in the form of scattered red points on a deep subcuticular flush; at first on the neck and chest, and spreading so rapidly that by the evening of the second day it may have invaded the entire skin. After persisting for two or three days it gradually fades. At its height the rash has a vivid scarlet hue, quite distinctive and unlike that seen in any other eruptive disease. It is an intense hyperæmia, and the anæmia produced by pressure instantly disappears. There may be fine punctiform hæmorrhages, which do not disappear on pressure. In some cases the rash does not become uniform but remains patchy, and intervals of normal skin separate large hyperæmic areas. Tiny papular elevations may sometimes be seen, but they are not so common as in measles. With each day the rash becomes of a darker color, and there may be in parts even a bluish-red shade. Smooth at the beginning, the skin gradually becomes rougher, and to the touch feels like "goose skin." At the height of the eruption sudaminal vesicles may develop, the fluid of which may become turbid. The entire skin may at the same time be covered with small yellow vesicles on a deep red background—*scarlatina miliaris*. McCollom lays stress upon the appearance of a punctate eruption in the arm-pits, groins, and on the roof of the mouth as positive proof of scarlet fever. Marked transverse lines at the bend of the elbow sometimes occur early.

Occasionally there are petechiæ, which in the malignant type of the disease become widespread and large. The eruption does not always appear upon the face. There may be a good deal of swelling of the skin, which feels uncomfortable and tense. The itching is variable; not as a rule intense at the height of the eruption. By the seventh or eighth day the rash has disappeared. The mucous membrane of the palate, the cheeks, and the tonsils present a vivid red, punctiform appearance. The tongue at first is red at the tip and edges, furred in the centre; and through the white fur are often seen the swollen red papillæ, which give the so-called "strawberry" appearance to the tongue, particularly if the child puts out the tip of the tongue between the lips. In a few days the "fur" desquamates and leaves the surface red and rough, and it is this condition which some writers call the "strawberry," or, better, the "raspberry" tongue. Enlargement of the papillæ was the only constant sign in 1,000 cases (McCollom). The breath often has a very heavy, sweet odor.

The pharyngeal symptoms are:

1. Slight redness, with swelling of the pillars of the fauces and of the

tonsils. 2. A more intense grade of swelling and infiltration of these parts with a follicular tonsillitis. 3. Diphtheroid angina with intense inflammation of all the pharyngeal structures and swelling of the glands below the jaw, and in very severe cases a thick brawny induration of all the tissues of the neck.

The fever, which sets in with such suddenness and intensity, may reach 105° or even 106° F. It persists with slight morning remissions, gradually declining with the disappearance of the rash. In mild cases the temperature may not reach 103° F.; on the other hand, in very severe cases there may be hyperpyrexia, ~~the thermometer registering~~ 108° F., or before death even 109° F.

The pulse ranges from 120 to 150; in severe cases with very high fever from 190 to 200. The respirations show an increase proportionate to the intensity of the fever. A leucocytosis is usually present, which may be high

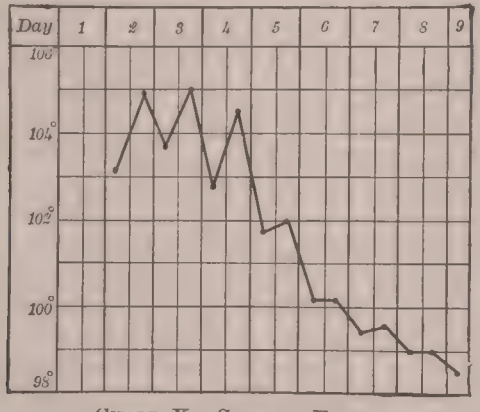

CHART X.—SCARLET FEVER.

(30,000 to 50,000 per c. mm.) in the severe cases. The gastrointestinal symptoms are not marked after the initial vomiting, and food is usually well taken. In some instances there are abdominal pains. The edge of the spleen may be palpable. The liver is not often enlarged. With the initial fever nervous symptoms are present in a majority of the cases; but as the rash comes out the headache and the slight nocturnal wandering disappear. The urine has the ordinary febrile characters, being scanty and high colored. Slight albuminuria is by no means infrequent during the stage of eruption. Careful examination of the urine should be made every day. There is no cause for alarm in the trace of albumin which is so often present, not even if it is associated with a few tube casts.

DESQUAMATION.—With the disappearance of the rash and the fever the skin looks somewhat stained, is dry, a little rough, and gradually the upper layer of the cuticle begins to separate. The process usually begins about the neck and chest, and flakes are gradually detached. The degree and character of the desquamation bear some relation to the intensity of the eruption. When the latter has been very vivid and of long standing large flakes may be thrown off. In rare instances the hair and even the nails have been shed. It must

not be forgotten that there are cases in which the desquamation has been prolonged, according to Trousseau, even to the seventh or eighth week. The entire process lasts from ten to fifteen or even twenty days.

Atypical Scarlet Fever.—Mild and Abortive Forms.—In cases of exceptional mildness the rash may be scarcely perceptible. During epidemics, when several children of a household are affected, one child sickens as if with scarlet fever, and has a sore throat and the "strawberry tongue," but the rash does not appear—*scarlatina sine eruptione*. In school epidemics a third or more of the cases may be without the rash. Desquamation, however, may follow, and in these very mild forms nephritis may occur.

Malignant Scarlet Fever.—*Fulminant Toxic Variety.*—With all the characteristics of an acute intoxication, the patient is overwhelmed by the intensity of the poison and may die within twenty-four or thirty-six hours. The disease sets in with great severity—high fever, extreme restlessness, headache, and delirium. The temperature may rise to 107° or even 108°, in rare cases even higher. Convulsions may occur and the initial delirium rapidly gives place to coma. The dyspnœa may be urgent; the pulse is very rapid and feeble.

Hæmorrhagic Form.—Hæmorrhages occur into the skin, and there are hæmaturia and epistaxis. In the erythematous rash scattered petechiæ appear, which gradually become more extensive, and ultimately the skin may be universally involved. Death may take place on the second or on the third day. While this form is perhaps more common in enfeebled children, I have twice known it to attack adults apparently in full health.

Anginose Form.—The throat symptoms appear early and progress rapidly: the fauces and tonsils swell and are covered with a thick membranous exudate, which may extend to the posterior wall of the pharynx, forward into the mouth, and upward into the nostrils. The glands of the neck rapidly enlarge. Necrosis occurs in the tissues of the throat, the fetor is extreme, the constitutional disturbance profound, and the child dies with the clinical picture of a malignant diphtheria. Occasionally the membrane extends into the trachea and the bronchi. The Eustachian tubes and the middle ear are usually involved. When death does not take place rapidly from toxæmia there may be extensive abscess formation in the tissues of the neck and sloughing. In the separation of deep sloughs about the tonsils the carotid artery may be opened, causing fatal hæmorrhage.

Septicæmic Form.—In this there is a severe secondary infection and death occurs in the second or third week from severe toxæmia.

Complications and Sequelæ.—Albuminuria.—At the height of the fever there is often a slight trace of albumin in the urine, which is not of special significance. In a majority of cases the kidneys escape without greater damage than occurs in other acute febrile affections.

Nephritis is most common in the second or third week and may follow a very mild attack. It may be delayed until the third or fourth week. As a rule, the earlier it occurs the more severe the attack. It occurs in from 10 to 20 per cent. of the cases. Three grades of cases may be recognized:

1. Acute hæmorrhagic nephritis. There may be suppression of urine or only a small quantity of bloody fluid laden with albumin and tube casts. Vomiting is constant, there are convulsions, and the child dies with the symp-

toms of acute uræmia. In severe epidemics there may be many cases of this sort, and an acute, rapidly fatal, nephritis due to the scarlet fever poison may occur without an exanthem.

2. Less severe cases without serious acute symptoms. There is a puffy appearance of the eyelids, with slight œdema of the feet; the urine is diminished in quantity, smoky, and contains albumin and tube casts. The kidney symptoms then dominate the entire case, the dropsy persists, and there may be effusion into the serous sacs. The condition may drag on and become chronic, or the patient may succumb to uræmic accidents. Fortunately, in a majority of the cases recovery takes place.

3. Cases so mild that they can scarcely be termed nephritis. The urine contains albumin and a few tube casts, but rarely blood. The œdema is extremely slight or transient, and the convalescence is scarcely interrupted. Occasionally, however, serious symptoms may supervene. Œdema of the glottis may prove rapidly fatal, and in one case of the kind a child under my care died of acute effusion into the pleural sacs.

In other cases the œdema disappears and the child improves, though he remains pale, and a slight amount of albumin persists in the urine for months or even for years. Recovery may ultimately take place or a chronic ~~interstitial~~ nephritis may follow.

Occasionally œdema occurs without albuminuria or signs of nephritis. Possibly it may be due to the anæmia; but there are instances in which marked changes have been found in the kidney after death, ~~even~~ when the urine did not show the features characteristic of nephritis.

Arthritis.—There are two forms: first, the severe scarlatinal pyæmia, with suppuration of one or more joints—part of a widespread streptococcus infection. This is an extremely serious and fatal form. Secondly, scarlatinal arthritis, analogous to that ~~occurring~~ in gonorrhœa and other infections. It occurs in the second or third week; many joints are attacked, particularly the small joints of the hands. The heart may be involved. Chorea, subcutaneous ~~fibroid~~ nodules, purpura, and pleurisy may be complications. The outlook is usually good.

Cardiac Complications.—In the severe septic cases a malignant endocarditis, sometimes with purulent pericarditis, closes the scene. Simple endocarditis is not uncommon. It may not be easy to say whether the apex systolic murmur, so often heard, signifies a valvular lesion. The persistence after convalescence, with signs of slight enlargement of the heart, may alone decide that the murmur indicated an organic change. As is the rule, such cases give no symptoms. And, lastly, there may be a severe toxic myocarditis, sometimes leading to acute dilatation and sudden death. It is to be borne in mind that the cardiac complications of the disease are often latent.

Acute bronchitis and broncho-pneumonia are not common. *Empyema* is an insidious and serious complication.

Ear Complications.—Common and serious, due to extension of the inflammation from the throat through the Eustachian tubes, they rank among the most frequent causes of deafness in children. The severe forms of membranous angina are almost always associated with otitis, which goes on to suppuration and to perforation of the drum. The process may extend to the labyrinth and rapidly produce deafness. In other instances there is suppura-

tion in the mastoid cells. In the necrosis which follows the middle-ear disease the facial nerve may be involved and paralysis follow. Later, still more serious complications may follow, such as thrombosis of the lateral sinus, meningitis, or abscess of the brain.

Adenitis.—In comparatively mild cases of scarlet fever the submaxillary lymph-glands may be swollen. In severer cases the swelling of the neck becomes extreme and extends beyond the limits of the glands. Acute phlegmonous inflammations may occur, leading to widespread destruction of tissue, in which vessels may be eroded and fatal hæmorrhage ensue. The suppurative processes may also involve the retro-pharyngeal tissues.

The swelling of the lymph-glands usually subsides, and within a few weeks even the most extensive enlargement gradually disappears. There are rare instances, however, in which the lymphadenitis becomes chronic, and the neck remains with a glandular collar which almost obliterates its outline. This may prove intractable to all ordinary measures of treatment. A case came under my observation in which, two years after scarlet fever, the neck was enormously enlarged and surrounded by a mass of firm brawny glands.

Nervous Complications.—Chorea occasionally complicates the arthritis and endocarditis. Sudden convulsions followed by hemiplegia may occur. In seven of my series of 120 cases of infantile hemiplegia the trouble came on during scarlet fever. Progressive paralysis of the limbs with wasting may present the features of a subacute ascending spinal paralysis. Thrombosis of the cerebral veins may occur. Mental symptoms, mania, and melancholia have been described.

Other rare complications and sequelæ are œdema of the eyelids, without nephritis, symmetrical gangrene, enteritis, noma, and perforation of the soft palate.

The fever may persist for several weeks after the disappearance of the rash, and the child may remain in a septic or typhoid state. This so-called scarlatinal typhoid is usually the result of some chronic suppurative process about the throat or the nose, occasionally the result of a chronic adenitis, and in a few cases nothing whatever can be found to account for the fever.

Measles may be concurrent or follow in the stage of convalescence.

Relapse is rare. It was noted in 7 per cent. of 12,000 (Caiger), in 1 per cent. of 1,520 cases (Newsholme), and in 3 per cent. of 5,000 cases (McCollom).

Diagnosis.—The diagnosis of scarlet fever is not difficult, but there are cases in which the true nature of the disease is for a time doubtful. The following are the most common conditions with which it may be confounded:

Acute Exfoliating Dermatitis.—This pseudo-exanthem simulates scarlet fever very closely. It has a sudden onset, with fever. The eruption spreads rapidly, is uniform, and after persisting for five or six days begins to fade. Even before it has entirely gone desquamation usually begins. Some of these cases cannot be distinguished from scarlet fever in the stage of eruption. The throat symptoms, however, are usually absent, and the tongue rarely shows the changes which are so marked in scarlet fever. In the desquamation of this affection the hair and nails are commonly affected. It is, too, a disease liable to recur. Some of the instances of second and third attacks of scarlet fever have been cases of this form of dermatitis.

Measles, which is distinguished by the longer period of invasion, the characteristic nature of the prodromes, and the later appearance of the rash. The greater intensity of the measly rash upon the face, the more papular character and the irregular crescentic distribution are distinguishing features in a majority of the cases. Other points are the absence in measles of the sore throat, the peculiar character of the desquamation, the absence of leucocytosis, and the presence of Koplik's sign.

Rötheln.—The rash of rubella is sometimes strikingly like that of scarlet fever, but in the great majority of cases the mistake could not arise. In cases of doubt the general symptoms are our best guide.

Septicæmia.—As already mentioned, the so-called puerperal or surgical scarlatina shows an eruption which may be identical in appearance with that of true scarlet fever.

Diphtheria.—The practitioner may be in doubt whether he is dealing with a case of scarlet fever with intense membranous angina, a true diphtheria with an erythematous rash, or coexisting scarlet fever and diphtheria. In the angina occurring early in and during the course of scarlet fever, though the clinical features may be those of true diphtheria, Löffler's bacilli are rarely found. On the other hand, in the membranous angina occurring during convalescence the bacilli are usually present. The rash in diphtheria is, after all, not so common, is limited usually to the trunk, is not so persistent, and is generally darker than the scarlatinal rash.

Scarlatina and diphtheria may coexist, but in a case presenting widespread erythema and extensive membranous angina with Löffler's bacilli it would puzzle Hippocrates to say whether the two diseases coexisted, or whether it was only an intense scarlatinal rash in diphtheria. Desquamation occurs in either case. The streptococcus angina is not so apt to extend to the larynx, nor are recurrences so common; but it is well to bear in mind that general infection may occur, that the membrane may spread downward with great rapidity, and, lastly, that all the nervous sequelæ of the Klebs-Löffler diphtheria may follow the streptococcus form.

Drug Rashes.—These are partial, and seldom more than a transient hyperæmia of the skin. Occasionally they are diffuse and intense, and in such cases very deceptive. They are not associated, however, with the characteristic symptoms of invasion. There is no fever, and with care the distinction can usually be made. They are most apt to follow the use of belladonna, quinine, and iodide of potassium. The antitoxin erythema is a frequent cause of doubt, particularly in hospitals for infectious diseases.

Coexistence of other Diseases.—Of 48,366 cases of scarlet fever in the Metropolitan Asylum Board Hospitals which were complicated by some other disease, in 1,094 cases the secondary infection was diphtheria, in 899 cases chicken-pox, in 703 measles, in 404 whooping-cough, in 55 erysipelas, in 11 enteric fever, and in 1 typhus fever (F. F. Caiger). Farnarier (1904) could collect only 39 undoubted cases of the coexistence of typhoid and scarlet fever.

How Long Is a Child Infective?—Usually, after desquamation is complete, in four or five weeks the danger is thought to be over, but the occurrence of so-called "return cases" shows that patients remain infective even at this stage. In 1894, with 2,593 patients from the Glasgow fever hospitals sent to their homes convalescent, fresh cases appeared in 70 of the houses (Chal-

N.Y. Bd. of Health. 30 days from adm. of pat.

mers). With 15,000 cases submitted to an average period of isolation of forty-nine days or under, the percentage of return cases was 1.86; with an average period of fifty to fifty-six days the percentage was 1.12; where the isolation extended to between fifty-seven and sixty-five days the percentage of return cases was 1 (Neech). This author suggests eight weeks as a minimum and thirteen weeks as a maximum. Special care should be taken of cases with rhinorrhœa and otorrhœa and throat trouble, as the secretions from these parts are probably of greater importance than the skin in the conveyance of the disease.

Prognosis.—As stated, the death-rate has been falling of late years. Epidemics differ remarkably in severity and the mortality is extremely variable. Among the better classes the death-rate is much lower than in hospital practice. There are physicians who have treated consecutively a hundred or more cases without a death. On the other hand, in hospitals and among the poorer classes the death-rate is considerable, ranging from 5 to 10 per cent. in mild epidemics to 20 or 30 per cent. in the very severe. In 1,000 cases reported from the Boston City Hospital by McCollom the death-rate was 9.8 per cent. There is a curious variability in the local mortality from this disease. In England, for example, in some years, certain counties enjoy almost immunity from fatal scarlet fever. The younger the child the greater the danger. In infants under one year the death-rate is very high. The great proportion of fatal cases occurs in children under six years of age. The unfavorable symptoms are very high fever, early mental disturbance with great jactitation, the occurrence of hæmorrhages (cutaneous or visceral), intense diphtheroid angina with cervical bubo, and signs of laryngeal obstruction. Nephritis is always a serious complication, and when setting in with suppression of the urine may quickly prove fatal; a large majority of the cases recover.

Prophylaxis.—Much may be done to prevent the spread of the disease if the physician exercises scrupulous care in each case. Much is to be expected from a rigid system of school inspection, and from the more general recognition of the importance of the latent cases and the persistence of the infection in the secretions of the nose and throat. The attendant in a case of scarlet fever should take the most careful precautions against the conveyance of the disease, wearing a gown in the room and thoroughly washing the hands and face after leaving the room. To the very busy practitioner the minutiæ of proper disinfection are very irksome, but it is his duty to carry out the most rigid disinfection possible, and intelligent people now expect it. The duration of quarantine varies with the attack: six to eight weeks is the average period. Patients with discharge from the ear or nose require longer isolation.

Treatment.—The patient may be treated at home or sent to an isolation hospital. The difficulty in *home treatment* is in securing complete isolation. The risks are well illustrated by the careful studies of Chapin, of Providence, who found that during eight years 26.1 per cent. of the 4,412 persons under twenty-one years of age in infected families took the disease. When practicable, it is better to send the other children out of the house. Chapin's experience on this point is most interesting. In seventeen years, from 652 families infected with scarlet fever, 1,051 children, none of whom had had the disease, were removed. Only 5 per cent. were attacked while away from

home. Nineteen who had been sent away from the infected houses were attacked on their return. In Great Britain a very considerable proportion of all patients are removed from their homes. In the segregation hospital groups of patients, from ten to twenty, are treated in separate wards. In the true isolation hospital each patient is in a separate room, and patients with different infectious diseases may be in adjacent rooms.

The disease cannot be cut short. In the presence of the severer forms we are still too often helpless. There is no disease, however, in which the successful issue and the avoidance of complications depend more upon the skilled judgment of the physician and the care with which his instructions are carried out.

The child should be isolated and placed in charge of a competent nurse. The temperature of the room should be constant and the ventilation thorough. The child should wear a light flannel nightgown, and the bedclothing should not be too heavy. The diet should consist of milk, buttermilk, whey, and ice cream; water and fruit juices should be freely given. With the fall of the temperature the diet may be increased and the child may gradually return to ordinary fare. When desquamation begins the child should be thoroughly rubbed every day, or every second day, with sweet oil, or carbolated vaseline, or a 5-per-cent. hydro-naphthol soap, which prevents the drying and the diffusion of the scales. ~~A 5- or 10-per-cent. solution of ichthyol in lanolin may be used.~~ An occasional warm bath may then be given. At any time during the attack the skin may be sponged with warm water. The patient may be allowed to get up after the temperature has been normal for ten days, but for at least three weeks from this time great care should be exercised to prevent exposure to cold. It must not be forgotten, also, that the renal complications are very apt to occur during the convalescence, and after all danger is apparently past. Ordinary cases do not require any medicine, or at the most a simple fever mixture, and during convalescence a bitter tonic. The bowels should be carefully regulated.

Special symptoms in the severe cases call for treatment.

When the fever is above 103° F. the extremities may be sponged with tepid water. In severe cases, with the temperature rapidly rising, this will not suffice, and more thorough measures of hydrotherapy should be practiced. With pronounced delirium and nervous symptoms the cold pack should be used. When the fever is rising rapidly but the child is not delirious, he should be placed in a warm bath, the temperature of which can be gradually lowered. The bath with the water at 80° is beneficial. In giving the cold pack a rubber sheet and a thick layer of blankets should be spread upon a sofa or a bed, and over them a sheet wrung out of cold water. The naked child is then laid upon it and wrapped in the blankets. An intense glow of heat quickly follows the preliminary chilling, and from time to time the blankets may be unfolded and the child sprinkled with cold water. The good effects which follow this plan of treatment are often striking, particularly in allaying the delirium and jactitation, and procuring quiet and refreshing sleep. Parents will object less, as a rule, to the warm bath gradually cooled than to any other form of hydrotherapy. The child may be removed from the warm bath, placed upon a sheet wrung out of tolerably cold water, and then folded in blankets. The ice-cap is very useful and may be kept

Cream + lactic may be added to the milk

Mouth should be kept clean + rinsed frequently with a mild antiseptic wash. Such as boric acid 4%. The nose + throat may be sprayed or irrigated with an alkaline soln. (saline or sodium bicarb)

℞ Throat sprays Diphtheria sire Diph. antitoxin (1000 units)

rickets. whooping. hydro. tri-nal abscess.

digitalis and it must by strophanthin strychnine
ephinephrin nitrous. ox. camphor

[illegible]

1915. 16445 deaths highest for many years
1914. 9144 "

constantly applied in cases in which there is high fever. Medicinal antipyretics are not of much service in comparison with cold water.

The throat symptoms, if mild, do not require much treatment. If severe, the local measures mentioned under diphtheria should be used. The nose should be kept clean, for which a simple alkaline douche, given gently, is best. Cold applications to the neck are to be preferred to hot, though it is sometimes difficult to get a child to submit to them. If cervical adenitis occurs, an ice bag should be applied, and with the first signs of suppuration an incision made. In connection with the throat, the ears should be specially looked after, and a careful disinfection of the mouth and fauces by suitable antiseptic solutions should be practiced. When the inflammation extends through the tubes to the middle ear, the practitioner should either himself examine daily the condition of the drum, or, when available, a specialist should be called in to assist him in the case. The careful watching of this membrane day by day and the puncturing of it if the tension becomes too great may save the hearing of the child. With the aid of cocaine the drum is readily punctured. The operation may be repeated at intervals if the pain and distention return. No complication of the disease is more serious than this extension of the inflammatory process to the ear.

The nephritis should be dealt with as in ordinary cases; indications for treatment will be found under the appropriate section. It is worth mentioning, however, that Jaccoud insists upon the great value of milk diet in scarlet fever as a preventive of nephritis.

Among other indications for treatment in the disease is cardiac weakness, which is usually the result of the direct action of the poison, and is best met by stimulants,

Serum Treatment.—As a streptococcus infection frequently complicates scarlet fever and is responsible for the secondary infections, the use of antistreptococcus serum seems rational, but it has not proved of great value in the acute stages. More is to be expected from it in the more chronic infections, in which also an autogenous vaccine may be useful. The dosage should be small at first and increased gradually.

V. MEASLES

(*Morbilli*)

Definition.—An acute, highly contagious fever with specific localization in the upper air passages and in the skin.

History.—Rhazes, an Arabian physician, in the ninth century described the disease with small-pox, of which it was believed to be a mild form until Sydenham separated them in the seventeenth century.

Etiology.—As a cause of death measles ranks first among the acute fevers of children. In 1909 there were 12,618 deaths from this disease in England and Wales. The death rate is highest in the second year.

The liability to infection is almost universal in persons unprotected by a previous attack. It is a disease of childhood, but, as shown in the widespread epidemics in the Farroe Islands and in the Fiji Islands, unprotected adults of

all ages are attacked. Within the first three months of life there is a relative immunity. Occasionally infants of a month or six weeks take the disease. Intra-uterine cases have been described, and a mother with measles may give birth to a child with the eruption, or the rash may appear in a few days.

The disease is endemic in cities, and becomes epidemic at intervals, prevailing most extensively in the cooler months, though this is by no means a fixed rule.

The germ of the disease is unknown. J. F. Anderson has shown that the blood of a patient inoculated into the Rhesus monkey produces after eight days a fever of short duration with a well-marked slight exanthem. The contagion is present in the blood, the secretions of the mouth and nose, and in the skin. In the eighteenth century Monro and others demonstrated the inoculability of the disease. Direct contagion is the most common. The poison is probably not in the expired air, but in the particles of mucus and in the sputum and the secretions of the mouth and nose, which, dried, are conveyed with the dust. An important point is the contagiousness of the disease in the pre-eruptive stage. A child with only the catarrhal symptoms may be at school and a source of active infection. Indirect contagion by means of fomites is very common. Measles may be thus conveyed by a third person, by clothes, and by infected toys. The germ soon loses its virulence.

Recurrence is rare. ~~Very~~ many cases of the supposed second and third attack represent mistakes in diagnosis. Relapse is occasionally seen, the symptoms recurring at intervals from ten to forty days; but it is not always easy to say ~~in a given case~~ whether there may not have been new infection from without.

Morbid Anatomy.—The catarrhal and inflammatory appearances seen post mortem have nothing characteristic. Fatal cases show, as a rule, broncho-pneumonia and an intense bronchial catarrh. The lymphatic elements all over the body are swollen, the tonsils, the lymph-glands, and the solitary and agminated follicles of the intestines. The spleen is rarely much enlarged. During convalescence latent tuberculous foci are very apt to become active.

Symptoms.—INCUBATION.—"From seven to eighteen days; oftenest fourteen." The child shows no special changes, but coryza and swelling of the cervical lymph-glands may be present. A leucocytosis has been observed, and the pulse is said to be slow.

INVASION.—In this period, lasting from three to four days, very rarely five or six, the child presents the symptoms of a feverish cold. The onset may be insidious, or it may start with great abruptness, even with a convulsion. There is not often a definite chill. Headache, nausea, and vomiting may usher in the severe cases. The common catarrhal symptoms are sneezing and running at the nose, redness of the eyes and lids, and cough. The fever is slight at first, but gradually there is pungent heat of the skin with turgescence of the face. Prodromal rashes precede the true eruption in a few cases, usually a blotchy erythema or scattered macules. The tongue is furred and the mucous membranes of the mouth and throat are hyperæmic, and frequently show a distinct punctiform rash. The fever of the stage of invasion may rise abruptly; more frequently it takes twenty-four or forty-eight hours to reach the fastigium. The pulse-rate increases with the fever, and may reach 140 or 160 per minute, gradually falling with defervescence.

Eruption.—"The symptoms increase till the fourth day. At that period (although sometimes a day later) little red spots, just like flea-bites, begin to come out on the forehead and the rest of the face. These increase both in size and number, group themselves in clusters, and mark the face with largish red spots of different figures. These red spots are formed by small red papules, thick set, and just raised above the level of the skin. The fact that they really protrude can scarcely be determined by the eye. It can, however, be ascertained by feeling the surface with the fingers. From the face—where they first appear—these spots spread downward to the breast and belly; afterward to the thighs and legs " (Sydenham). The papules may feel quite shotty, but do not extend deeply. On the trunk and extremities the swelling of the skin is not so noticeable, the color of the rash not so intense and often

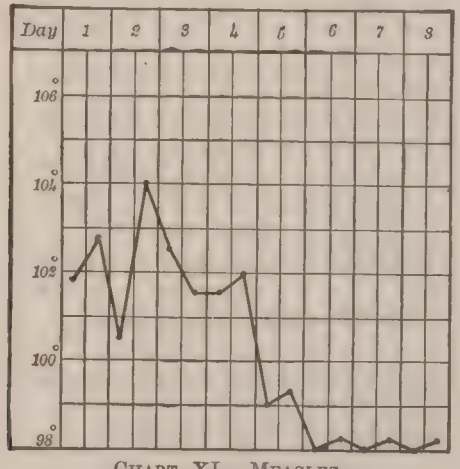

Chart XI.—Measles.

less uniform. The mottled, blotchy character is seen most clearly on the chest and the abdomen. It is hyperæmic and disappears on pressure, but in the malignant cases it may become of a deep rose, inclining to purple. These general symptoms do not abate with the occurrence of the eruption, but persist until the end of the fifth or the sixth day, when they lessen. Among peculiarities of the rash may be mentioned the development of numerous miliary vesicles and the occurrence of petechiæ, which are seen occasionally even in cases of moderate severity. Recession of the rash, so much dwelt upon by older writers, is rarely seen. When the "measles sink in suddenly after they have begun to come out, and then the patient is seized with anxiety and a swooning comes on, it is a sign of speedy death" (Rhazes). In reality it is the failing circulation which causes the rash to fade.

Buccal spots were described by Filatow in 1895, and by Koplik in 1896. They are seen on a level with the bases of the lower milk molars on either side, or at the line of junction of the molars when the jaws are closed. They are white or bluish-white specks, surrounded by red areolæ. Their importance depends upon ~~the fact of~~ their early appearance and remarkable constancy in the disease—six-sevenths of all cases (Heubner), 97.7 per cent. of 214 cases (Balme).

The fauces may be injected, and there is sometimes an eruption of scattered spots over the entire mucous membrane of the mouth. Ringer was in the habit of calling attention to opaque white spots on the mucous membrane of the lips.

Desquamation.—After the rash fades desquamation begins, usually in the form of fine scales, more rarely in large flakes. It bears a definite relationship to the extent and intensity of the rash. In mild cases desquamation may take only a few days, in severe cases several weeks.

The tonsils and the cervical lymph glands may be slightly swollen and sore; sometimes there is a polyadenitis.

During the course leucocytosis is absent. Its presence generally points to a complication. Myelocytes are often present in small numbers during the eruption (Tileston).

Atypical Measles.—Variations in the course of the disease are not common. There is an *attenuated* form, in which the child may be well by the fourth or fifth day, ~~An~~ *abortive* form, in which the initial symptoms may be present, but no eruption appears—*morbilli sine morbillis.*

Malignant or *black measles* is seen most frequently in the widespread epidemics, but it is also met with in institutions, and occasionally in general practice among children, more rarely in adults. Hæmorrhages occur into the skin and from the mucous membranes; there is very high fever, and all the features of a profound toxæmia, often with cyanosis, dyspnœa, and extreme cardiac weakness. Death may occur from the second to the sixth day.

Complications.—Those of the air passages are the most serious. The *coryza* may become chronic and lead to irritation of the lymphoid tissues of the naso-pharynx, leaving enlarged tonsils and adenoids, and not improbably leaving these parts less able to resist tuberculous invasion. *Epistaxis* may sometimes be serious. *Laryngitis* is not uncommon: the voice becomes husky and the cough croupy in character. Œdema of the glottis and pseudo-membranous inflammation are rare. Ulceration, abscess, and even perichondritis may occur.

Bronchitis and Broncho-pneumonia.—In every case of severe measles the possibility of the existing bronchitis extending to the small tubes and causing ~~lobular~~ pneumonia has to be considered. It is more apt to occur at the height of the eruption or as desquamation begins. The high mortality in institutions is due to this complication, which, as Sydenham remarked, kills more than the small-pox. (For the symptoms, see the section on the subject.)

Lobar pneumonia is less common. *Thrombosis* in veins has been described.

Severe *stomatitis* may follow the slight catarrhal form. In institutions *cancrum oris* or *gangrenous stomatitis* is a terrible complication, attacking sometimes many children. *Parotitis* occasionally occurs. *Intestinal catarrh* and *acute colitis* are special complications of some epidemics.

Nephritis is less rare than is stated. It is not very uncommon to see cases of chronic ~~Bright's disease~~ which date from an attack of measles. Vulvitis may be present as part of the general catarrhal condition.

Endocarditis is rare. *Arthritis* may follow the fever, or come on at its height. It may be general and severe. I saw an instance in which anchylosis of the jaw followed an attack of measles in a child of four years. The conjunctivitis may be followed by *keratitis*. *Otitis media* is not at all uncom-

N.H Board of Health - qua. only 5 days after appearance of rash.

mon and may lead to perforation of the drum or mastoid disease. *Hemiplegia* is a most serious complication. In 4 of my series of 120 cases the hemiplegia came on during measles. It usually persists. *Paraplegia* due to acute myelitis has been described. *Polyneuritis* may occur with widespread atrophy. Acute mania, *meningitis, abscess of the brain,* and *multiple sclerosis* are among the rare complications or sequelæ. *Scarlet fever* may occur with measles. *Whooping-cough* not infrequently follows measles.

Diagnosis.—During the prevalence of an epidemic the disease is easily recognized. Physicians to isolation hospitals appreciate the practical difficulties. On several occasions I had patients with measles sent to the small-pox hospital, and it is well to bear in mind that in adults the beginning of the eruption on the face, its nodular character, and the isolation of the spots may be suggestive of variola. From scarlet fever measles is distinguished by the longer initial stage with characteristic symptoms, and the blotchy irregular character of the rash, so unlike the diffuse uniform erythema. In measles the mouth (with the early Koplik sign), in scarlet fever the throat, is chiefly affected. Occasionally in measles, when the throat is very sore and the eruption pretty diffuse, there may at first be difficulty in determining which disease is present, but a few days should suffice to make the diagnosis clear. As a rule there is no leucocytosis. It may be extremely difficult to distinguish from rötheln. I have more than once known practitioners of large experience unable to agree upon a diagnosis. The shorter prodromal stage, the absence of oculo-nasal catarrh, and the slighter fever in many cases are perhaps the most important features. It is difficult to speak definitely about the distinctions in the rash, though perhaps the more uniform distribution and the absence of the crescentic arrangement are more constant in rötheln. In Africans the disease is easily recognized; the papules stand out with great plainness, often in groups; the hyperæmia is to be seen on all but the very black skins. The distribution of the rash, the coryza, and the rash in the mouth are important points. Of drug eruptions, that induced by copaiba is very like measles, but is readily distinguished by the absence of fever and catarrh. Antipyrin, chloral, and quinine rashes rarely cause any difficulty in diagnosis. The serum exanthem of a diphtheria antitoxin may be difficult to recognize. In adults the acute malignant measles may resemble typhus fever. Occasionally erythema multiforme may simulate measles.

Prognosis.—The mortality from the disease itself is not high, but the pulmonary complications render it one of the most serious of the diseases of children. In some epidemics, particularly in institutions and in armies, the death-rate may be high, not so much from the fever itself as from the extension of the catarrhal symptoms to the finer bronchial tubes. Imported in 1875 from Sydney by H.M.S. Dido to the Fiji Islands, 40,000 out of 150,000 of the inhabitants died in four months. Panum, the distinguished Danish physician, described the widespread and fatal epidemic which decimated the inhabitants of the Faroe Islands in 1846. In private practice the mortality is from 2 to 3 per cent.; in hospitals from 6 to 8 or 10 per cent.

Prophylaxis.—The difficulty is inherent in the prolonged incubation and the four days of invasion, during which the catarrhal symptoms are marked, and the disease is contagious, and one often finds that the quarantine which has been carried out so efficiently has been in vain. From contact with cases

in the stage of invasion and mild cases with scarcely any fever the disease is readily disseminated through schools and conveyed to healthy children in the every-day contact with each other on the streets, in the squares and playgrounds. Once manifested, the child should be carefully quarantined and all possible precautions taken against the spread of the disease in the house. As the germ of measles seems to have a feeble vitality the quarantine need not be so protracted as in scarlet fever, four weeks usually being sufficient.

Treatment.—Confinement to bed in a well-ventilated room and a light diet with abundance of water are the only measures necessary in cases of uncomplicated measles. The fever rarely reaches a dangerous height. If it does it may be lowered by sponging or by the tepid bath gradually reduced. If the rash does not come out well, warm drinks and a hot bath will hasten its maturation. The bowels should be freely opened. If the cough is distressing compresses should be applied to the chest and inhalations of the compound tincture of benzoin given. Small doses of paregoric or codein may be given. The patient should be kept in bed for a few days after the fever subsides. During desquamation the skin should be oiled daily, and warm baths given to facilitate the process. The mouth and nostrils should be carefully cleansed, even in mild cases. The convalescence from measles is the most important stage of the disease. Watchfulness and care may prevent serious pulmonary complications. The frequency with which the mothers of children with simple or tuberculous broncho-pneumonia tell us that "the child caught cold after measles," and the contemplation of the mortality bills, should make us extremely careful in our management of this affection.

VI. RUBELLA

(*Rötheln, German Measles*)

This exanthem has also the names of *rubeola notha*, or epidemic roseola, and, as it is supposed to present features common to both, has been also known as hybrid measles or hybrid scarlet fever. It is now generally regarded, however, as a separate and distinct affection.

Etiology.—It is propagated by contagion and spreads with great rapidity. It frequently attacks adults, and the occurrence of either measles or scarlet fever in childhood is no protection against it. The epidemics of it are often very extensive.

Symptoms.—These are usually mild, and it is altogether a less serious affection than measles. Very exceptionally, as in the epidemics studied by Cheadle, the symptoms are severe.

The stage of incubation is two weeks or even longer.

In the stage of invasion there are chilliness, headache, pains in the back and legs, and coryza. A macular, rose-red eruption on the throat is a constant symptom, and, indeed, it was on this account that it was originally regarded as a hybrid, having the sore throat of scarlet fever and the rash of measles. There may be very slight fever. In 30 per cent. of Edwards's cases the temperature did not rise above 100°. The duration of this stage is somewhat variable. The rash usually appears on the first day, some writers say on the

employed. Persons [illegible] receive the usual treatment.

second, and others again give the duration of the stage of invasion as three days. Griffith places it at two days. The eruption comes out first on the face, then on the chest, and gradually extends so that within twenty-four hours it is scattered over the whole body. It may be the first symptom noted by the mother. The eruption consists of a number of round or oval, slightly raised spots, pinkish-red in color, usually discrete, but sometimes confluent.

The color of the rash is somewhat brighter than in measles. The patches are less distinctly crescentic. After persisting for two or three days (sometimes longer), it gradually fades and there is a slight furfuraceous desquamation. The rash persists as a rule longer than in scarlet fever or measles, and the skin is slightly stained after it. In some cases the rash is scarlatiniform, which may even follow a measly eruption. The lymphatic glands of the neck are frequently swollen, and, when the eruption is very intense and diffuse, the lymph-glands in the other parts of the body.

There are no special complications. The disease usually progresses favorably; but in rare instances, as in those reported by Cheadle, the symptoms are of greater severity. Albuminuria, arthritis, or even nephritis may occur. Pneumonia and colitis have been present in some epidemics. Icterus has been seen.

Diagnosis.—The slightness of the prodromal symptoms, the mildness or the absence of the fever, the more diffuse character of the rash, its rose-red color, and the early enlargement of the cervical glands, are the chief points of distinction between rötheln and measles.

The treatment is that of a simple febrile affection.

"Fourth Disease."—Clement Dukes, in a paper on the confusion of two different diseases under the name rubella, describes what he calls a "fourth disease," in which the body is covered in a few hours with a diffuse exanthem of a bright red color, almost scarlatiniform in appearance. The face may remain quite free. The desquamation is more marked than in rötheln.

Erythema Infectiosum.—Under this term there has been described in Germany, particularly by Escherich, a feebly contagious disease, characterized by a rose-red, maculo-papular rash, appearing chiefly between the ages of four and twelve. It has occurred in epidemic form in the spring and summer. It has followed outbreaks of measles or of rötheln. The most characteristic feature is the morbilliform eruption on the extremities, chiefly on the extensor surfaces. The trunk as a rule remains free.

VII. EPIDEMIC PAROTITIS

(*Mumps*)

Definition.—A specific infectious disease, characterized by swelling of the salivary glands and a special liability to orchitis in males.

Hippocrates described the disease and its peculiarities—an affection of children and young male adults, the absence of suppuration, and the orchitis.

Etiology.—The nature of the virus is unknown.

It is endemic in large centres of population, and at certain seasons, particularly spring and autumn, the cases increase rapidly. It is met most fre-

quently in childhood and adolescence. Very young infants and adults are seldom attacked. Males are somewhat more frequently affected than females. In institutions, barracks, and schools the disease has been known to attack over 90 per cent. of the residents. It may be curiously localized in a city or district, or even in one part of a school or barrack. The disease is contagious and spreads from patient to patient. The infection may persist for as long as six weeks. It may be congenital, and Hale White has reported a case in which the mother and her new-born child were attacked at the same time.

A remarkable idiopathic, non-specific parotitis may follow injury or disease of the abdominal or pelvic organs (see Diseases of the Salivary Glands).

Symptoms.—The period of incubation is from two to three weeks, and there are rarely any symptoms during this stage. The invasion is marked by fever, which is usually slight, rarely rising above 101°, but in exceptionally severe cases reaches 103° or 104°. The child complains of pain just below the ear on one side, where a slight swelling is noticed, which increases gradually, and within forty-eight hours there is great enlargement of the neck and side of the cheek. The swelling passes forward in front of the ear, the lobe of which is lifted, and back beneath the sterno-mastoid muscle. The other side usually becomes affected within a day or two, and the whole neck is surrounded by a collar of doughy infiltration. Only one gland may be involved, or an interval of four or five days may elapse before the other side is involved. The submaxillary and sublingual glands become swollen, though not always; in a few cases they may be alone attacked. The lachrymal glands may be involved. The greatest inconvenience is experienced in taking food, for the patient is unable to open the mouth, and even speech and deglutition become difficult. There may be an increase in the secretion of the saliva, but the reverse is sometimes the case. The mucous membrane of the mouth and throat may be slightly inflamed. There is seldom great pain, but an unpleasant feeling of tension and tightness. There may be earache, even otitis media, and slight impairment of hearing.

After persisting for from seven to ten days, the swelling gradually subsides and the child rapidly regains his strength and health and is none the worse for the attack.

Occasionally the disease is very severe and characterized by high fever, delirium, and great prostration. The patient may even lapse into a typhoid condition.

Relapse is rare, but there may be within a few weeks two or three slight recurrences, in which I have known the cervical glands to enlarge. A second or even a third attack may occur.

Orchitis.—Excessively rare before puberty, it occurs usually about the eighth day, and more particularly if the boy is allowed to leave his bed. One or both testicles may be involved. The swelling may be great, and occasionally effusion takes place into the tunica vaginalis. The orchitis may occur before the parotitis, or in rare instances may be the only manifestation of the infection (*orchitis parotidea*). The inflammation increases for three or four days, and resolution takes place gradually. There may be a muco-purulent discharge from the urethra. In severe cases atrophy may follow, fortunately as a rule only in one organ; occurring in both before puberty the natural development is usually checked. Even when both testicles are atrophied and

Special care should be taken to keep the mouth clean
by cleansing after feeding and the use of alkaline antiseptic
solutions.

Bellevue or Children's Hospital Medical School

small, sexual vigor may be retained. The proportion of cases of orchitis varies in different epidemics; 211 cases occurred in 699 cases, and 103 cases of atrophy followed 163 instances of orchitis (Comby). No satisfactory explanation of this remarkable metastasis has been given. Military surgeons, who see so much of the disease in young recruits, have suggested the transference of the virus to the penis with the fingers and its transmission along the urethra.

A vulvo-vaginitis sometimes occurs in girls, and the breasts may become enlarged and tender. Mastitis has been seen in boys. Involvement of the ovaries is rare. The thyroid gland may enlarge in the attack, and there have been features suggestive of acute pancreatitis.

Complications and Sequelæ.—Of these the cerebral affections are perhaps the most serious. As already mentioned, there may be delirium and high fever. In rare instances meningitis has been found. Hemiplegia and coma may also occur. A majority of the fatal cases are associated with meningeal symptoms. These, of course, are very rare in comparison with the frequency of the disease; yet, in the Index Catalogue, under this caption, there are six fatal cases mentioned. In some epidemics the cerebral complications are much more marked than in others. Acute mania has occurred, and there are instances on record of insanity following the disease.

Arthritis, albuminuria, nephritis, with acute uræmia and convulsions, endocarditis, pleurisy, facial paralysis, hemiplegia, and peripheral neuritis are occasional complications.

Suppuration of the gland is an extremely rare complication. Gangrene has occasionally occurred. The special senses may be seriously involved. Deafness may occur, and may be permanent. Affections of the eye are rare, but optic neuritis with atrophy has been described.

Chronic hypertrophy of the gland may follow.

Diagnosis.—The diagnosis of the disease is usually easy. The position of the swelling in front of and below the ear and the elevation of the lobe on the affected side definitely fix the locality of the swelling. In children inflammation of the parotid, apart from ordinary mumps, is excessively rare.

Treatment.—It is well to keep the patient in bed during the height of the disease. The bowels should be freely opened, and the patient given a light liquid diet. No medicine is required unless the fever is high, in which case aconite may be given. Cold compresses may be placed on the gland, but children, as a rule, prefer hot applications. A pad of cotton wadding covered with oil silk is the best application. Suppuration is hardly ever to be dreaded, even though the gland become very tense. Should redness and tenderness develop, leeches may be used. With delirium and head symptoms the ice-cap may be applied. For the orchitis, rest, with support and protection of the swollen gland with cotton-wool, is usually sufficient.

VIII. TYPHUS FEVER

Definition.—An acute infectious disease of unknown origin, highly contagious, characterized by sudden onset, maculated and hæmorrhagic rash, marked nervous symptoms, and a cyclical course terminating by crisis, usually

about the end of the second week. Post mortem there are no special lesions other than those associated with fever.

The disease is known by the names of hospital fever, spotted fever, jail fever, camp fever, and ship fever, and in Germany is called *exanthematic* typhus, in contradistinction to *abdominal* typhus. The word signifies "smoke" or "mist" in Greek and was used by Hippocrates to describe any condition with a tendency to stupor. In the eighteenth century the name was given by de Sauvages to the common putrid or pestilential fever, and the general use came in through its adoption by Cullen.

Etiology.—Typhus has been one of the great *epidemics* of the world, whose history, as Hirsch remarks, is written in those dark pages which tell of the grievous visitations of mankind by war, famine, and misery. It now exists in a few endemic areas, where from time to time sporadic cases occur. Ireland was terribly scourged by the disease between the years 1817 and 1819, and again in 1846. It prevailed extensively in all the large cities of Great Britain and the Continent. Its gradual disappearance has been one of the great triumphs of sanitation. In 1875 in England and Wales there were 1,499 deaths from the disease. Of late years the name typhus has rarely appeared in the Registrar-General's report. In the United States and Canada it prevailed extensively in the early years of the nineteenth century, and there were severe epidemics in the wake of the Irish immigrations in '46 and '47. At present epidemics are rare, but it is endemic in parts of Russia and in the Slav countries.

Sporadic typhus fever offers peculiarities which are apt to make its recognition difficult. There may be outbreaks of a few cases, the origin of which may be very difficult to trace, though, as Kelsch long ago suggested, tramps may convey the disease, while they themselves are healthy. Two such limited outbreaks came under my observation, one at the House of Refuge, Montreal, in 1877, in which eleven persons were affected, and the second in 1901 at the Johns Hopkins Hospital, where three cases occurred.

A question of interest has arisen as to the relation of typhus fever to the cases of fever, 255 in number, studied by Brill in New York. In all probability it is a sporadic type of typhus, an opinion to which Brill himself leans, and which has been confirmed by the studies of Anderson and Goldberger. Beginning with the usual prodromes, the fever increases rapidly and reaches a maximum about the third or fourth day, where it remains fairly constant between 103° and 104°. On the 5th or 6th day an eruption appears, maculo-papular in type, dull red in color, rarely hæmorrhagic, not appearing in crops, not disappearing on pressure, and neither profuse as in measles nor diffuse as in typical typhus; there may be only a few hundred spots. The rash persists until the crisis and then fades rapidly. The patients are much prostrated, with severe headache, but no abdominal symptoms. Constipation is usually a marked feature. After persisting for 12 to 15 days, the fever declines rapidly, usually with a critical fall, and there is a speedy convalescence. The blood cultures are negative and there is no agglutination with any of the organisms of the typhoid group. The disease does not spread to other patients in the wards or in the home. It is very rarely fatal, and post mortem results show no lesions of the intestines.

The so-called Manchurian type met with in the far East is very similar,

Plotz isolates organism - agglutinates
anaer. Bacilli test sera
snake
obs. gram. positive bacillus from 0.5 to 1.5 μ in length
not acid fast - no capsule, spores stained by
appropriate methods.
first anaerobically - Calif. cuniculi.

In California 1916 - not published till January

and has the same low mortality and slight degree of infectiousness. On the other hand, the typhus fever prevailing in Mexico City, where it is known as Tabardillo, is more severe, and in its study Ricketts of Chicago fell a victim. Neither the Rocky Mountain spotted fever, nor the Flood or River fever of Japan is identical with typhus.

The disease is associated with filth and overcrowding. In epidemics it is one of the most highly contagious of all diseases, and those in attendance upon patients are almost invariably attacked. In a period of twenty-five years in Ireland, among 1,230 physicians attached to institutions, 550 died of this disease. The virus, thrown off apparently from the lungs and from the skin, attaches itself particularly to the clothing and to the furniture of the room, and may retain its activity for a long time. The nature of the poison is as yet unknown, but Nicole, Anderson and Goldberger have been able to transmit the disease to monkeys, and Nicole has shown that lice fed on the typhus-infected chimpanzee can transmit the disease to monkeys.

Morbid Anatomy.—The anatomical changes are those which result from intense fever. The blood is dark and fluid; the muscles are of a deep red color, and often show a granular degeneration, particularly in the heart; the liver is enlarged and soft and may have a dull clay-like lustre; the kidneys are swollen; there is moderate enlargement of the spleen, and a general hyperplasia of the lymph-follicles. Peyer's glands are not ulcerated. Bronchial catarrh is usually, and hypostatic congestion of the lungs often, present. The skin shows the petechial rash.

Symptoms.—Incubation.—This is placed at about twelve days, but it may be less. There may be ill-defined feelings of discomfort. As a rule, however, the *invasion* is abrupt and marked by chills or a single rigor, followed by fever. The chills may recur during the first few days, and there is headache with pains in the back and legs. There is early prostration, and the patient is glad to take to his bed at once. The temperature is high at first, and may attain its maximum on the second or third day. The pulse is full, rapid, and not so frequently dicrotic as in typhoid. The tongue is furred and white, and there is an early tendency to dryness. The face is flushed, the eyes congested, and the expression dull and stupid. Vomiting may be a distressing symptom. In severe cases mental symptoms are present from the outset, either a mild febrile delirium or an excited, active, almost maniacal condition. Bronchial catarrh is common.

Stage of Eruption.—From the third to the fifth day the eruption appears—first upon the abdomen and upper part of the chest, and then upon the extremities and face; occurring so rapidly that in two or three days it is all out. There are two elements in the eruption: a subcuticular mottling, "a fine, irregular, dusky red mottling, as if below the surface of the skin some little distance, and seen through a semi-opaque medium" (Buchanan); and distinct papular rose-spots which change to petechiæ. In some instances the petechial rash comes out with the rose-spots. Collie describes the rash as consisting of three parts: rose-colored spots which disappear on pressure, dark-red spots which are modified by pressure, and petechiæ upon which pressure produces no effect. In children the rash at first may present a striking resemblance to that of measles and give as a whole a curiously mottled appearance to the skin. The term mulberry rash is sometimes applied to it. In mild

cases the eruption is slight, but even then is largely petechial in character. As the rash is hæmorrhagic, it does not disappear after death. Usually the skin is dry, so that sudaminal vesicles are not common. It is stated by some authors that a distinctive odor is present. During the second week the general symptoms are much aggravated. The prostration becomes more marked, the delirium more intense, and the fever rises. The patient lies on his back with a dull, expressionless face, flushed cheeks, injected conjunctivæ, and contracted pupils. The pulse increases in frequency and is feebler; the face

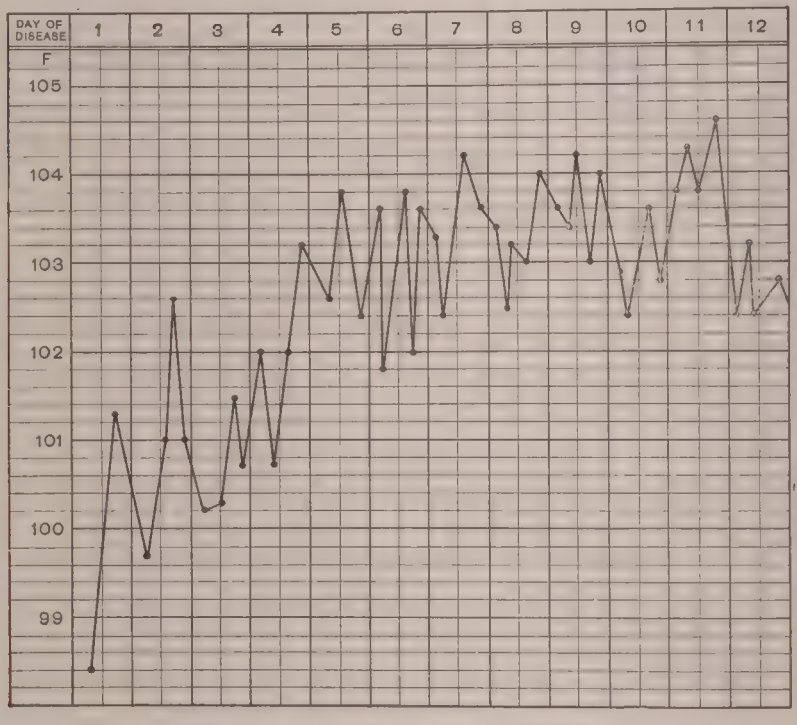

CHART XII.—TYPHUS FEVER (Murchison).

is dusky, and the condition becomes more serious. Retention of urine is common. Coma-vigil is frequent, a condition in which the patient lies with open eyes, but quite unconscious; with it there may be subsultus tendinum and picking at the bedclothes. The tongue is dry, brown, and cracked, and there are sordes on the teeth. Respiration is accelerated, the heart's action becomes more and more enfeebled, and death takes place from exhaustion. In favorable cases about the end of the second week occurs the crisis, in which, often after a deep sleep, the patient awakes feeling much better and with a clear mind. The temperature falls, and although the prostration may be extreme convalescence is rapid and relapse very rare. This abrupt termination by crisis is in striking contrast to the mode of termination in typhoid fever.

FEVER.—The temperature rises steadily during the first four or five days, and the morning remissions are not marked. The maximum is usually attained by the fifth day, when the temperature may be 105°, 106°, or 107° F.

deafness is a

In mild cases it seldom rises above 103° F. After reaching its maximum the fever generally continues with slight morning remissions until the twelfth or fourteenth day, when the crisis occurs, during which the temperature may fall below normal within twelve or twenty-four hours. Preceding a fatal termination, there is usually a rapid rise in the fever to 108° or even 109° F.

The heart may early show signs of weakness. The first sound becomes feeble and almost inaudible, and a systolic murmur at the apex is not infrequent. Hypostatic congestion of the lungs occurs in all severe cases. The brain symptoms are usually more pronounced than in typhoid, and the delirium is more constant. A slight leucocytosis is ~~more~~ common, ~~than in typhoid~~.

The urine in typhus shows the usual febrile increase of urea and uric acid. The chlorides diminish or disappear. Albumin is present in a large proportion of the cases, but nephritis seldom occurs.

Variations in the course of the disease are naturally common. There are malignant cases which rapidly prove fatal within two or three days; the so-called *typhus siderans*. On the other hand, during epidemics there are extremely mild cases in which the fever is slight, the delirium absent, and convalescence is established by the tenth day.

Complications and Sequelæ.—Broncho-pneumonia is perhaps the most common complication. It may pass on to gangrene. In certain epidemics gangrene of the toes, the hands, or the nose, and in children noma or cancrum oris, have occurred. Meningitis is rare. Paralyses, which are probably due to a post-febrile neuritis, are not very uncommon. Septic processes, such as parotitis and abscesses in the subcutaneous tissues and in the joints, are occasionally met with. Nephritis is rare. Hæmatemesis may occur.

Prognosis.—The mortality ranges in different epidemics from 12 to 20 per cent. It is very slight in the young. Children, who are quite as frequently attacked as adults, rarely die. After middle age the mortality is high, in some epidemics 50 per cent. Death usually occurs toward the close of the second week and is due to the toxæmia. In the third week it more commonly results from pneumonia.

Diagnosis.—During an epidemic there is rarely any doubt, for the disease presents distinctive general characters. Isolated cases and the form described by Brill may be very difficult to distinguish from typhoid fever. While in typical instances the eruption in the two affections is very different, yet taken alone it may be deceptive, since in typhoid fever a roseolous rash may be abundant and there may be occasionally a subcuticular mottling and even petechiæ. The difference in the onset, particularly in the temperature, is marked; but cases in which it is important to make an accurate diagnosis are not usually seen until the fourth or fifth day. The suddenness of the onset, the greater frequency of the chill, and the early prostration are the distinctive features in typhus. The brain symptoms, too, are earlier. It is easy to put down on paper elaborate differential distinctions, which are practically useless at the bedside. The Widal reaction and blood cultures are important aids, but in sporadic cases the diagnosis is sometimes extremely difficult. I have seen Murchison himself in doubt, and more than once I have known the diagnosis to be deferred until the *sectio cadaveris*. Severe cerebro-spinal fever may closely simulate typhus at the outset, but the

diagnosis is usually clear within a few days. Malignant variola also has certain features in common with severe typhus, but the greater extent of the hæmorrhages and the bleeding from the mucous membranes make the diagnosis clear within a short time. The rash at first resembles that of measles, but in the latter the eruption is brighter red in color, often crescentic or irregular in arrangement, and appears first on the face.

The frequency with which other diseases are mistaken for typhus is shown by the fact that during and following the epidemic of 1881 in New York 108 cases were wrongly diagnosed—one-eighth of the entire number—and sent to the Riverside Hospital (F. W. Chapin).

Treatment.—The general management of the disease is like that of typhoid fever. Hydrotherapy should be thoroughly and systematically employed. Judging from the good results which we have obtained by this method in typhoid cases with nervous symptoms, much may be expected from it. Medicinal antipyretics are even less suitable than in typhoid, as the tendency to heart-weakness is often more pronounced. As a rule, the patients require from the outset a supporting treatment; water should be freely given, and alcohol in suitable doses, according to the condition of the pulse.

The bowels may be kept open by mild aperients. The so-called specific medication, by sulphocarbolates, ~~the sulphides~~, carbolic acid, etc., is not commended by those who have had the largest experience. The special nervous symptoms and the pulmonary symptoms should be dealt with as in typhoid fever. In epidemics, when the conditions of the climate are suitable, the patients are best treated in tents in the open air.

IX. YELLOW FEVER

Definition.—A fever of tropical and subtropical countries, characterized by a toxæmia of varying intensity, with jaundice, albuminuria, and a marked tendency to hæmorrhage, especially from the stomach, causing the "black vomit." The specific organism has not ~~yet~~ been found, but the disease is ~~capable of being~~ transmitted through the bite of a mosquito, the *Stegomyia fasciata.*

Etiology.—The disease prevails endemically in certain sections of the Spanish Main. Until recently it has existed in Cuba. From these regions it occasionally extended and, under suitable conditions, prevailed epidemically in the Southern States. Now and then it was brought to the large seaports of the Atlantic coast. Formerly it occurred extensively in the United States. In the latter part of the eighteenth century and the beginning of the nineteenth frightful epidemics prevailed in Philadelphia and other Northern cities. The epidemic of 1793, in Philadelphia, so graphically described by Matthew Carey, was the most serious that has ever visited any city of the Middle States. The mortality, as given by Carey, during the months of August, September, October, and November, was 4,041, of whom 3,435 died in the months of September and October. The population of the city at the time was only 40,000. Epidemics occurred in the United States in 1797, 1798, 1799, and in 1802, when the disease prevailed slightly in Boston and extensively in Baltimore. In 1803 and 1805 it again appeared; then for

many years the outbreaks were slight and localized. In 1853 the disease raged throughout the Southern States. There were moderately severe epidemics in 1867, 1873, and 1878, and still milder ones in 1897, 1898, and 1899. In July, 1899, a local outbreak occurred in the Soldiers' Home at Hampton, Va. There were 45 cases, with 13 deaths. In September, 1903, yellow fever became epidemic along the Mexican side of the Rio Grande. It crossed into Texas and prevailed in several of the border towns. In Laredo there were 1,014 cases, with 107 deaths. The efficient work of the public health service is shown by the differences between New Laredo on the Mexican border, just across the river, where 50 per cent. of the population contracted the disease, and Laredo, Texas, in which only 10 per cent. out of a population of 10,000 were attacked. In Europe it has occasionally gained a foothold, but there have been no widespread epidemics in the Spanish ports. The disease has existed on the west coast of Africa, and the late Rubert Boyce claimed that it is still widely prevalent. It is sometimes carried to ports in Great Britain and France, but it has never extended into these countries. The *Stegomyia fasciata* exists here, but it is not very abundant and, as Ross points out, yellow fever is a disease in which the parasites live a very short time in the human host, unlike malaria. The infective period in a case lasts only about three days, so that, unless the stegomyia index is high, as in Havana, the disease has no chance to reach epidemic form.

The epidemics in the United States have always been in the summer and autumn months, disappearing rapidly with the onset of cold weather.

Guitéras recognizes three areas of infection: (1) The focal zone in which the disease is never absent, including Vera Cruz, Rio, and other Spanish-American ports. (2) The perifocal zone or regions of periodic epidemics, including the ports of the tropical Atlantic in America and Africa. (3) The zone of accidental epidemics, lying between the 35th and 15th parallels of north latitude.

Mode of Transmission.—No belief has been more strong among the laity than that the disease is transmitted by infected clothing, and quarantine efforts are chiefly directed to the disinfection of fomites of all sorts shipped from infected ports. The remarkable series of experiments carried out by the Yellow Fever Commission of the United States Army, consisting of Drs. Walter Reed, Carroll, Lazear, and Agramonte, have demonstrated conclusively that the disease cannot be conveyed in this way. At Camp Lazear, Cuba, a frame house was so constructed as to shut out the sunlight and fresh air, and the vestibule was thoroughly screened. The average temperature for sixty-three days was kept about 76° F. Boxes filled with sheets, pillow-slips, blankets, etc., contaminated by contact with cases of yellow fever and the discharges, were placed in the house. Dr. R. P. Cooke and two privates of the hospital corps, all non-immunes, entered this building and ~~unpacked the boxes, and~~ for a period of twenty days occupied the room, each morning packing the infected articles in the boxes, and at night unpacking them. In their experiments with the fomites, seven, in all, non-immune subjects during the period of sixty-three days lived in contact with the fomites and remained perfectly well. These experiments, conducted in the most rigid and scientific manner, completely discredit the belief in the transmission of the disease by fomites.

Carlos Finlay, of Havana, in 1881 suggested that the disease was transmitted by mosquitoes. Stimulated by the work of Ross on malaria, the American Commission above named has demonstrated conclusively that yellow fever is transferred by a mosquito, *Stegomyia fasciata*, previously fed on the blood of infected persons. The Commission showed also that in non-immunes the disease could be produced by either the subcutaneous or the intravenous injection of blood taken from patients suffering with the disease.

An interval of about twelve days or more after contamination appears to be necessary before the mosquito is capable of introducing the infection. The bite at an early period after contamination does not confer immunity against a subsequent attack. The period of incubation in 13 cases of experimental yellow fever varied from forty-one hours to five days and seventeen hours.

We must bear testimony to the heroism of the young soldiers who voluntarily, without compensation and purely in the interests of humanity, submitted to the experiments, and also to the zeal with which members of our profession, have, at great personal risk, attempted to solve the riddle of this most serious disease. The death of Dr. Lazear, of the American Commission, and of Dr. Myers, of the Liverpool Commission, adds two more names to the already long roll of the martyrs of science.

As Reed pointed out, the mosquito theory fits in with well-recognized facts in connection with the epidemics. After the importation of a case into an uninfected region, a definite period elapses, rarely less than two weeks, before a second case occurs. Like malaria, the disease prevails most during the mosquito season, and disappears with the appearance of frost. Probably, too, as in very malarious districts, the disease is kept up by its prevalence in a very mild form among children. As Guitéras remarks, "the foci of endemicity are essentially maintained by the creole infant population, which is subject to the disease in a very mild form." In all probability the immunity which is acquired by prolonged residence in a locality in which the disease is endemic is due to the occurrence of very slight attacks.

One attack does not always confer immunity. Rosenau reports two attacks within a period of eight years, and Libby two attacks within a period of two years.

The *specific germ* has not yet been discovered.

Morbid Anatomy.—The skin is more or less jaundiced, even though the patient did not appear yellow before death. Cutaneous hæmorrhages may be present. No specific or distinctive internal lesions have been found. The blood-serum may contain hæmoglobin, owing to destruction of the red cells, just as in pernicious malaria. The heart sometimes, not invariably, shows fatty change; the stomach presents more or less hyperæmia of the mucosa with catarrhal swelling. It contains the material which, ejected during life, is known as the *black vomit*. The essential ingredient in this is transformed blood-pigment. There is often general glandular enlargement; the cervical, axillary and mesenteric groups are most involved. The liver is usually of a pale yellow or brownish-yellow color, and the cells are in various stages of fatty degeneration. From the date of Louis' observations at Gibraltar in 1828, the appearances of this organ have been very carefully studied, and some have thought the changes in it to be characteristic. Fatty degeneration

transmitted [illegible]

and regions of necrosis are present in all cases. The kidneys always show traces of diffuse nephritis. The epithelium of the convoluted tubules is swollen and very granular; there may also be necrotic changes.

Symptoms.—The incubation is usually three or four days; in 13 experimental cases it ranged from forty-one hours to five days, seventeen hours. The onset is sudden, as a rule, without premonitory symptoms, and in the early hours of the morning. Chilly feelings are common, and are usually associated with headache and very severe pains in the back and limbs. The fever rises rapidly and the skin feels very hot and dry. The tongue is furred, but moist; the throat sore. Nausea and vomiting are not constant, and become more intense on the second or third day. The bowels are usually constipated. The following, in detail, are the more important characteristics:

Facies.—Even as early as the first morning the patient may present a characteristic facies, one of the three distinguishing features of the disease, which Guitéras describes as follows: The face is flushed, more so than in any other acute infectious disease at such an early period. The eyes are injected, the color is a bright red, and there may be a slight tumefaction of the eyelids and of the lips. Even at this early date there is to be noticed in connection with the injection of the superficial capillaries of the face and conjunctivæ a slight icteroid tint, and "the early manifestation of jaundice is undoubtedly the most characteristic feature of the facies of yellow fever."

The Fever.—On the morning of the first day the temperature may range from 100° to 106° F., usually it is between 102° and 103° F. During the evening of the first day and the morning of the second day the temperature keeps about the same. There is a slight diurnal variation on the second and third day. In very mild cases the fever may fall on the evening of the second or on the morning of the third day, or in abortive cases even at the end of twenty-four hours. In cases that are to terminate favorably the defervescence takes place by lysis during a period of two or three days. The remission or stage of *calm*, as it has been called, is succeeded by a febrile reaction or secondary fever, which lasts one, two, or three days, and in favorable cases falls by a short lysis. On the other hand, in fatal cases the temperature is continuous, becomes higher than in the initial fever, and death follows shortly.

The Pulse.—On the first day the pulse is rarely more than 100 or 110. On the second or third day, while the fever still keeps up, the pulse begins to fall, as much perhaps as 20 beats, while the temperature has risen 1.5° or 2°. On the evening of the third day there may be a temperature range of 103° and a pulse of only 75, or "a temperature between 103° and 104° with a pulse running from 70 to 80." This important diagnostic feature was first described by Faget, of New Orleans. During defervescence the pulse may become still lower, down to 50, 48, or 45, or even as low as 30; a slow pulse at this period is not the special circulatory feature of the disease, but *the slowing of the pulse with a steady or even rising temperature.*

Albuminuria.—This, the third characteristic symptom of the disease, occurs as early as the evening of the third day. Guitéras says very truly that it is very rare so early in other fevers except those of an unusually severe type. "Even in the mild cases that do not go to bed—cases of 'walking yellow fever'—on the second, third, or fourth day of the disease albuminuria will show itself." It may be quite transient. In the severer cases the amount of

albumin is very large, and there may be numerous tube casts and all the signs of an acute nephritis; or complete suppression may supervene, and death occurs in uræmic convulsions or coma within twenty-four or thirty-six hours.

Gastric Features.—*"Black Vomit."*—Irritability of the stomach is present from the very outset, and the vomited matter consists of the contents of the stomach, and subsequently of mucus and a grayish fluid. In the third stage of the disease the vomiting becomes more pronounced and in the severe cases is characterized by the presence of blood. It may be copious and forcible, producing much pain in the abdomen and along the gullet. There is nothing specific in this "black vomit," which consists of altered blood, and it is not necessarily a fatal symptom, though occurring only in the severer forms of the disease. Other hæmorrhagic features may be present—petechiæ on the skin and bleeding from the gums or from other mucous membranes. The bowels are usually constipated, the stools not clay-colored, except late in the disease. They are sometimes tarry from the presence of altered blood.

Mental Features.—In very severe cases the onset may be with active delirium. "As a rule, in a majority of cases, even when there is black vomit, there is a peculiar alertness; the patient watches everything going on about him with a peculiar intensity and liveliness. This may be due in part to the terror the disease inspires" (Guitéras).

Relapses occasionally occur. Among the varieties of the disease it is important to recognize the mild cases, characterized by slight fever, continuing for one or two days, and succeeded by a rapid convalescence. In the absence of a prevailing epidemic they would scarcely be recognized as yellow fever. Cases of greater severity have high fever and the features of the disease are well marked—vomiting, extreme prostration, and hæmorrhages. And, lastly, in the malignant form the patient is overwhelmed by the intensity of the fever, and death takes place in two or three days.

In severe cases convalescence may be complicated by parotitis, abscesses in various parts of the body, and diarrhœa.

Diagnosis.—(*a*) From Dengue.—The difficulty in the differential diagnosis of these two diseases lies in their frequent coexistence, as during the epidemic of 1897 in parts of the Southern States. During the autumn of 1897 the profession of Texas was divided on the question of the existence of yellow fever in the State, some claiming that the disease was dengue, others, including Guitéras and West, that yellow fever also existed. In a majority of the cases the three diagnostic points upon which Guitéras lays stress—the facies, the albuminuria, and the slowing of the pulse with maintenance or elevation of the fever—are sufficient for the diagnosis. He states, too, that jaundice, which does sometimes occur in dengue, rarely appears as early as the second or third day of the disease, and on this much stress should be laid. Hæmorrhages are much less common in dengue, but that they do occur has been recognized by authorities ever since the time of Rush.

(*b*) From Malarial Fever.—In the early stages of an epidemic cases are very apt to be mistaken for malarial fever. In the Southern States the outbreaks have usually been in the late summer months, the very season in which the æstivo-autumnal fever prevails. Among the points to be specially noted is the absence of early jaundice. Even in the most intense types of malarial infection the color of the skin is rarely changed within four or five

days. To the experienced eye the facies would be of considerable help if the case was seen from the outset. Albumin is rarely present in the urine so early as the second day in a malarial infection. Other important points are the marked swelling of the spleen in malaria, while in yellow fever it is not much enlarged. Hæmorrhages, and particularly the black vomit, epistaxis, and bleeding gums are very rare in malarial infection. In the so-called hæmorrhagic malarial fever the patient has usually had previous attacks of malaria. Hæmaturia is a prominent feature, while in yellow fever it is by no means frequent. A special point of greater importance, perhaps, than any of these general symptomatic features is the examination of the blood for malarial parasites. The work of the army surgeons in Cuba showed that in a large proportion of cases there is not much difficulty in recognizing the æstivo-autumnal fever from yellow fever.

Prognosis.—In its graver forms yellow fever is one of the most fatal of epidemic diseases. The mortality has ranged, in various epidemics, from 15 to 85 per cent. In heavy drinkers and those who have been exposed to hardships the death-rate is much higher than among the better classes. In the epidemic of 1878, in New Orleans, while the mortality in hospitals was over 50 per cent. of the white and 21 per cent. of the colored patients, in private practice it was not more than 10 per cent. among the white patients. The death-rate was very low in the epidemic of 1897.

Prophylaxis.—The clearing of Havana by Colonel Gorgas was a direct outcome of the work of Reed and his colleagues. The city, with 250,000 people, had been infected continuously for 130 years. Non-immunes came in at the rate of 20,000 a year, and there were 6,000 children born. The city was divided into districts, each under the charge of an inspector, whose work was arranged under three heads: (1) To prevent the breeding of stegomyia mosquitoes. (2) To destroy those that had become infected. (3) To prevent mosquitoes becoming infected by protecting the sick so that they could not be bitten by mosquitoes.

The work was begun in February, 1901, and the last case of yellow fever occurred in September of that year, since which date, with the exception of a slight return, the city has been free.

At Panama in 1904, the date of the American occupation, the serious problem was how to fight yellow fever. Conditions were such that it took sixteen months before the disease disappeared. There has been no return. It is interesting to note that in the yellow fever wards at Ancon during 1905 all the physicians and nurses were non-immune, but not one of them contracted the disease, as the wards were so screened that no stegomyia mosquitoes could get at the patients to become infected.

Treatment.—Careful nursing and a symptomatic plan of treatment probably give the best results. The patient should be at rest in bed and for the first few days the diet should consist of very simple fluids. Elimination is an important part of treatment. Water should be given as freely as possible, best in the form of cold carbonated alkaline water. The bowels should be opened by a calomel and saline purge and enemata used if necessary. If there is vomiting, fluid should be given by the bowel or by infusion. Ice in small quantities, iced champagne or cocaine (gr. ¼, 0.016 gm.) may be tried. The fever should be treated by hydrotherapy, sponges, packs or baths being used. The alkaline

treatment is favorably regarded, sodium bicarbonate in full doses being given at short intervals and as much alkaline water as possible. For gastric and intestinal hæmorrhage the perchloride of iron or oil of turpentine may be given in doses of 15 minims (1 c.c.). Uræmic symptoms are best treated by the hot baths or packs, the free administration of fluid and hot bowel irrigations. Stimulants, especially strychnine, should be used during the second stage when the heart becomes feeble and rapid.

X. DENGUE

Definition.—An acute infectious disease of tropical and subtropical regions, characterized by febrile paroxysms, pains in the joints and muscles, an initial erythematous and a terminal polymorphous eruption. It is known as *break-bone* fever from the atrocious character of the pain, and *dandy fever* from the stiff, dandified gait. The word dengue is supposed to be derived from a Spanish, or possibly Hindostance, equivalent of the word dandy.

History and Geographical Distribution.—The disease was first recognized in 1779 in Cairo and in Java, where Bylon described the outbreak in Batavia. There have been widespread epidemics in India and China. The description by Benjamin Rush of the epidemic in Philadelphia in 1780 is one of the first and one of the very best accounts of the disease. Between 1824 and 1828 it was prevalent at intervals in India and in the Southern States. S. H. Dickson gives a graphic description of the disease as it appeared in Charleston in 1828. Since that date there have been four or five widespread epidemics in tropical countries and on this continent along the Gulf States, the last in the summer of 1897. None of the recent epidemics have extended into the Northern States, but in 1888 it prevailed as far north as Virginia. It has prevailed in the Philippine Islands among the United States troops and among the natives.

Etiology.—The rapidity of diffusion and the pandemic character are the two most important features of dengue. There is no disease, not even influenza, which attacks so large a proportion of the population. In Galveston, in 1897, 20,000 people were attacked within two months. In 1903 Graham showed that the disease could be transmitted to healthy persons by the bite of the mosquito *Culex fatigans*, an observation confirmed by Ashburn and Craig. The specific germ is still undetermined, but is probably ultramicroscopic.

As the disease is rarely fatal, no observations have been made upon its pathological anatomy.

Symptoms.—The period of incubation is from three to five days, during which the patient feels well. The attack sets in suddenly with headache, chilly feelings, and intense aching pains in the joints and muscles. The temperature rises gradually, and may reach 106° or 107°. The pulse is rapid, and there are the other phenomena associated with acute fever—loss of appetite, coated tongue, slight nocturnal delirium, and concentrated urine. The face has a suffused, bloated appearance, the eyes are injected, and the visible mucous membranes are flushed. There is a congested erythematous state of the skin. Rush's description of the pains is worth quoting, as in it the epithet

Bull. 1917. July 28.
h.106)

S.
(calopus)

Mansen says proves that Stegonyia ingui- respond with

Cambridians.— Cleland Bradley & McDonald.

break-bone occurs in the literature for the first time. "The pains which accompanied this fever were exquisitely severe in the head, back, and limbs. The pains in the head were sometimes in the back parts of it, and at other times they occupied only the eyeballs. In some people the pains were so acute in their backs and hips that they could not lie in bed. In others the pains affected the neck and arms, so as to produce in one instance a difficulty of moving the fingers of the right hand. They all complained more or less of a soreness in the seats of these pains, particularly when they occupied the head and eyeballs. A few complained of their flesh being sore to the touch in every part of the body. From these circumstances the disease was sometimes believed to be a rheumatism, but its more general name among all classes of people was the break-bone fever." The large and small joints are affected, sometimes in succession, and become swollen, red, and painful. In some cases cutaneous hyperæsthesia has been noted. Hæmorrhage from the mucous membranes was noted by Rush, and black vomit has also been described.

The fever gradually reaches its maximum by the third or fourth day; the patient then enters upon the apyretic period, which may last from two to four days, and in which he feels prostrated and stiff. A second paroxysm of fever then occurs, and the pains return. In a large number of cases an eruption is common, which, judging from the description, has nothing distinctive, being sometimes macular, like that of measles, sometimes diffuse and scarlatiniform, or papular, or lichen-like. In other instances the rash has been described as urticarial, or even vesicular. The rash may persist for a month after the symptoms have disappeared. Certain writers describe inflammation and hyperæmia of the mucous membrane of the nose, mouth and pharynx. Enlargement of the lymph-glands is not uncommon, and may persist for weeks after the disappearance of the fever. Convalescence is often protracted, and there is a degree of mental and physical prostration out of all proportion to the severity of the primary attack. The pains in the joints or muscles, sometimes very local, may persist for weeks. Rush refers to the former, stating that a young lady after recovery said it should be called break-heart, not break-bone, fever. The average duration of a moderate attack is from seven to eight days. Dengue is very seldom fatal. Dickson saw three deaths in the Charleston epidemic.

Complications are rare. Insomnia and occasionally delirium, resembling somewhat the alcoholic form, have been observed, and convulsions in children. Atrophy of the muscles may occur after the attack. A relapse may occur even as late as two weeks.

Diagnosis.—The diagnosis of the disease, prevailing as it does in epidemic form and attacking all classes indiscriminately, rarely offers any special difficulty. Isolated cases might be mistaken at first for rheumatic fever. The seven-day fever of East Indian ports is believed to be dengue. It is a sporadic fever of the hot weather, attacking a large proportion of Europeans within the first year or two of their arrival. Possibly, as Rogers thinks, it may be a distinct disease, and it is variously known in India as ephemeral fever, mild malaria, or simple continued fever. It is characterized by early and severe pains in the back and limbs, and a fever of six to seven days' duration.

Treatment.—This is entirely symptomatic. Quinine is stated to be a prophylactic, but on insufficient grounds. Hydrotherapy may be employed to

reduce the fever. The salicylates or antipyrin may be tried for the pains, which usually, however, require opium. During convalescence iodide of potassium is recommended for the arthritic pains, and tonics are indicated.

XI. ACUTE POLIO-MYELITIS

(*Heine-Medin's Disease*)

Definition.—An acute infection occurring in both epidemic and sporadic forms, characterized anatomically by widespread lesions of the nervous system, with special localization in a majority of the cases in the anterior horns of the gray matter in the spinal cord—hence the common name, polio-myelitis anterior.

History.—In 1840 von Heine separated this type from other forms of paralysis and in 1887 Medin called attention to its occurrence in widespread epidemics, which have been specially studied in Sweden by Wickham, Harbitz, and others. Within the past ten years serious outbreaks have occurred in many parts of the United States and Canada. The incidence of the disease has also slightly increased in Great Britain and on the Continent of Europe, while in Sweden and Norway and parts of Austria the disease has assumed epidemic proportions. In New York City in 1907-8 there were about 2,000 cases, with a mortality of 6 to 7 per cent.; in 1910 throughout the United States there were between eight and nine thousand cases reported.

Etiology.—In its epidemic behavior the disease resembles closely cerebro-spinal fever. Sporadic cases occur in all communities and under at present unknown conditions increase at times to epidemic proportions. It prevails in the late summer and autumn.

Age is a most important predisposing element; a great majority of all cases occur in children in the first dentition. The more prevalent the epidemic form the greater the proportion of young adults attacked. Males and females are about equally attacked. Overexertion, injury, exposure are mentioned as possible factors.

The degree of contagiousness from person to person is slight, and in this the disease resembles cerebro-spinal fever and pneumonia, but the precise mode of transmission has not yet been determined.

The infecting agent is as yet unknown. The studies of Flexner, Lewis, and others have shown that the virus belongs to the class of filterable organisms and is very resistant to external agencies. It has not been cultivated. The infective agent is present in the brain and spinal cord, in the naso-pharyngeal secretions and in the blood. The disease is inoculable into monkeys and may be transmitted from one animal to another. It has been transmitted also by intracerebral injection of an emulsion made from flies which had fed on the spinal cord of a monkey dead of the disease. An important point is that the virus passes from the central nervous system in the monkey to the nasal mucosa and vice versa, and the application of the virus to this part is a ready means of inoculation. It has also been found in the tonsils and pharyngeal mucosa of children.

So far as we know, the disease is transmitted either directly by contact

Flexner. Am. J. Dis. Ch. May 1915: 353

Infectious agents in nasal and buccal secretions - gains accepted supp. resp. tr. of others

Forms: paralytic
meningeal
abortive

Carriers

Here an infectious & communicable disease caused by a minute filterable virus organism - invading cent. nerv. syst.

In recent N.Y. epidemic - more in towns in N.Y. City than in State
ages 1.7 to over 16. Hospitals. 10% over 16 (N.Y. City excluded)
Disease conveyed chiefly by contact - carriers [illegible]

[illegible]

[illegible]

Route of infection - nasal mucous membrane to lymphatics
channels of olfactory lobes, Sheridan's + other nerve tissues.
Virus in nasal secretions - carriers.

[illegible]

Flexner. J.A.M.A. July 22. 16.
Incub. none in mild cases -
may vary - virus leaves body in secretions of nose, throat + intestines
and spread about by flies.
carried by lymphatics + cent. nerv. syst.
Insects. may be mechanical carriers.
Dem. anomalies. not proved.
Indiv. susceptibility varies
attack of variously -

Virus of Po. exists in cent. nerv. syst., + mucous
not detected in blood. Healthy persons
infected by mucous membrane of throat + nose
Virus destroyed by sunlight.

Virus varies in virulence - rendered
stronger by passage through rabbit
[illegible]
[illegible]
[illegible]

May affect intervertebral abdominal ganglia

anatomical.
class. 1. Non-paralytic type - mic. meningitis.
2. abortive type.
3. Type with cortical paralysis
4. " " spinal & [illegible]

Kopelik. Arch. Ped. 1916. 33 - nov 8.
Types. 1. abortive - dorsum sore. paralysis. ni chr'dness
fever. headache. vomiting. slight r.s. &
neck, nec. or dri. kernigs

2. bulbo-spinal
3. cerebral meningeal
4. bulbo-pontine.

Glen. Incubation - 4 - [illegible] days
others 14 days [illegible]
[illegible]

fever. irritability, hyperaesthesia.
pain muscles & back legs thighs arms. Pulse rapid high. temp. 101-103°
drowsiness heaviness often - often twitching & jerking of legs.
Stiffness of neck & back. Tendon reflexes gen. absent.
Sp. fluid clear - increase of cells & globulin.
Paralysis - 3-4 days - acute period 7-10 days.

or possibly by the intervention of a healthy individual who may act as a carrier. In cities the distribution is more independent of sanitary conditions than in the common children's diseases.

Morbid Anatomy.—One of the most striking results of recent researches has been to demonstrate how widespread the lesions are in the nervous system. We can no longer regard it as an affection limited to the anterior horns of the gray matter of the spinal cord, but a widespread poliomyelo-encephalitis with meningeal complications.

Swelling of the spleen and a marked general hyperplasia of the lymphoid apparatus have been found. The cerebro-spinal fluid is usually increased but clear. The pia mater is hyperæmic and moist, but without exudate. Cases in which the cerebral symptoms have been pronounced show swelling and flattening of the convolutions, with hyperæmia of the gray matter and here and there small hæmorrhages. The changes in the spinal cord are very characteristic. The meninges are moist, the pia is hyperæmic, sometimes with small capillary hæmorrhages. On section the cut surface bulges, the grey matter is hyperæmic, appearing as a reddened H, or the redness is limited to the anterior horns, which may show spots of hæmorrhage. These changes may be localized to the swellings of the cord or extend throughout its entire extent. Microscopically there is small-celled infiltration about the vessels of the meninges, most marked in the lumbar and cervical swellings. The infiltration extends into the fissures of the cord and follows the blood-vessels. The amount of meningeal implication is much more intense than is indicated macroscopically. In the cord itself the smaller blood-vessels are distended, hæmorrhages occur in the gray matter, there is marked perivascular infiltration, chiefly of lymphocytes, which collect about the vessels, forming definite foci. Sometimes the majority of the cells are polynuclear leucocytes. The ganglion cells, usually those of the anterior horns, degenerate and gradually disappear, changes probably secondary to the acute vascular alterations. Foci of infiltration and widespread œdema may be present in the white matter of the cord. In the fatal cases there are changes in the medulla and pons of much the same nature, but the ganglion cells rarely show such widespread destruction.

The path of invasion of the virus has not yet been definitely determined, nor is it known whether it reaches the nervous system through the blood-vessels or the lymphatics. Flexner and Lewis have shown that the infection can travel by the sheath of the sciatic nerve to the cord.

Symptoms.—The incubation period is from 5 to 10 days, during which the patient may complain of headache and pains and stiffness of the limbs. These prodromal symptoms, more common in the epidemic form, may be absent in the sporadic cases, and a child who has gone to bed perfectly well awakens in the morning with the paralysis and slight fever.

The studies of the past two or three years have shown a number of well-characterized types, of which the following are the most important:

(*a*) Abortive Form.—In epidemics, just as in cerebro-spinal fever, there are cases of illness with the general symptoms of infection, and indications of cerebro-spinal irritation, but without any motor disturbances. The symptoms pass away and the nature of the trouble remains doubtful, nor would suspicion be aroused were it not for the existence of other cases. It is inter-

esting to note that Anderson and Frost have shown the presence of specific immune bodies in the blood of these cases.

(*b*) Common Poliomyelitic or Sporadic Type.—The paralysis is abrupt in its onset, reaches its maximum in a very short time, showing the irregularity and lack of symmetry which is characteristic of the disease. One or both arms may be affected, or one arm and one leg, or both legs, or it may be the right leg and left arm, or vice versa. In the arm the paralysis is rarely complete, the upper-arm muscles may be most affected or the lower-arm group; muscles acting functionally together, with centres near each other in the spinal cord, are paralyzed together. In this type the bladder and rectum are rarely involved.

(*c*) Progressive Ascending Type.—A certain number of cases, particularly in epidemics, run a course similar to Landry's paralysis, with which, no doubt, some of them have been confounded. The disease begins in the legs with the usual initial symptoms, the paralysis extends upward, involving the arms and the trunk, and death may occur with bulbar symptoms from the third to the fifth day. In the Swedish epidemic of 1905 of the 159 cases which died within the first two weeks, 45 presented this type.

(*d*) Bulbar Form.—It has long been known that occasionally in the ordinary spinal paralysis of children the cerebral nerves are involved, but in the epidemic form the disease may begin with paralysis of the ocular, facial, lingual, or pharyngeal muscles. The patient has fever, and the local picture depends upon the extent and distribution of the lesions in the medulla and pons. In the 1905 Swedish epidemic there were 34 cases in which the cerebral nerves were alone involved, and in the New York epidemic this localization was not very uncommon. A fatal result may follow extension of the bulbar symptoms.

(*e*) Meningitic Form.—This is important, as the cases simulate closely and are apt to be mistaken for cerebro-spinal fever. The picture is one of an acute meningitis—headache, pain and stiffness in the neck, vomiting, pain and rigidity in the back, drowsiness and unconsciousness. The disease may begin with the paralytic features and subsequently show the meningeal complications. Convulsions and Kernig's sign may be present. A serious difficulty is that the two diseases may prevail together, and only the careful examination of the cerebro-spinal fluid may give a differential diagnosis.

(*f*) Cerebral Type.—Here the picture is that which we have learned to recognize as the acute encephalitis or polio-encephalitis of children, a description of which we owe to von Strümpell. The disease sets in suddenly, with fever, vomiting and convulsions, followed by paralysis of one side of the body or one limb. Many of the patients die, others recover and present the usual after-picture of the cerebral hemiplegia of children. A large proportion of the cases of this disease probably represent this type of the sporadic form of acute infectious polio-myelo-encephalitis.

(*g*) Polyneuritic Form.—Many cases of the ordinary type, a majority, I should say, of the sporadic form, are painless. It is one of the features of the epidemic form that the patients complain much more of pain. This is particularly the case in a form which stimulates a polyneuritis. There is pain in the affected limbs, particularly on movement, with tenderness on pressure along the nerves and on pressing the muscles; the paralysis may

Lovett & Martin. J.A.M.A. June 11. 1916

The paralysis usually not a complete loss of power but a weakening
e.g. III totally paralyzed to 958 partially paralyzed muscle groups. 9/11.
Of course many grades. As practical paralysis is unmanned so has
to work out some scale. Ours is a percentage.

Skin: 11 of muscular groups selected by fully opposing balancers
" " " " " children is very unstable.
22 groups on each side.

Results: Distribution much more widespread than usually thought: e.g.
rarely one muscle alone, or only 1 leg. if both legs then the arm
Paralysis is severest in proximal muscles toward the trunk.
" " muscles " " " hand.

Muscular fatigue - may be from overuse. Small degree may be very harmful.
Nervous cases - many so regarded really owing some from weakness.
Muscle training is superior to massage.
Lateral muscles paralyzed about 4 years - showed pain later.
Suggestion to walk against fully contracted muscle not found useful.

anything which causes anterior bending of the spine causes pain.

Collected a good deal. J. A. M. A. [illegible].

Urol. Inst. Berl. Dept. 7.

Spinalfluidforschung. Must be taken with great [illegible].

Spinalfluid. Microscopical amount of proteins, often very slightly increased.
Sugar, acidum q. diff. reaction. Microscopic cells = albumoglobulin.
Pathologic colloidal reaction in paralysis as in normal fluids
cells. 15 to 20 upon 1 cmm. usually largest as monocytes. rarely polymorphonuclear.
albumoglobulin slight- moderate increased.
Wassermann reaction. best diagnostic from syphilis.

Mitteilg IV. Vers. Ostdtsch. Urol. 1916. 27. 29
" " Stett 21. 1

extend like neuritis, involving chiefly the peripheral extensor muscle groups, and be followed by rapid wasting.

Diagnosis.—In the ordinary spinal sporadic cases there is rarely any difficulty. An important point to remember is that in periods of epidemic prevalence the disease presents an extraordinary number of clinical types. Some cases run a course like an acute infection, others have the picture of Landry's paralysis, in others again meningeal symptoms predominate, or there may be hyperæsthesia and pain, with the picture of a polyneuritis.

It seems not improbable that some obscure cases of meningitis are really instances of sporadic poliomyelitis. The same may be said of the acute encephalitis in children causing hemiplegia. The extraordinary complexity of the symptoms makes the diagnosis very difficult, so that we must look for help in the examination of the blood and spinal fluid and the testing the biological reactions of immunity.

If lumbar puncture is done early the cerebro-spinal fluid may be slightly turbid. The fluid contains a large amount of protein and gives a positive reaction to Noguchi's butyric acid test for globulin. This is one of the earliest features and reaches its maximum just before paralysis appears. By this some abortive cases of poliomyelitis have been recognized. The test is done as follows: Two parts of the cerebro-spinal fluid free from blood are mixed with five parts of a 10 per cent. butyric acid solution in physiological salt solution, heated and boiled for a brief period. One part of a normal solution of sodium hydroxide is then added and the whole is boiled again for a few seconds. The usual quantities employed are 0.2 c. c. of spinal fluid, 0.5 c. c. of butyric acid solution, and 0.1 c. c. of sodium hydroxide solution. The reaction consists in the appearance of a granular precipitate which settles at the bottom of the tube, leaving a clear fluid. The greater the amount of protein the quicker and more distinct the reaction. One hour may be required to obtain a reaction in specimens weak in protein, but the time period should not be longer than two hours. This reaction is not peculiar to poliomyelitis, but there is little chance of confusion with the other diseases in which it is given.

The diagnosis from peripheral neuritis may be very difficult; in both the paralysis is of the legs, with wasting, loss of reflexes, and the bladder and rectum may be involved. Loss of the vibrating sensation tested with a large tuning fork is more common in peripheral neuritis, and later the electrical changes and the action of degeneration may be distinctive.

Course.—After the acute features have subsided there is little change for two or three weeks, after which improvement begins. This may continue for two or three months. The atrophy becomes evident in a few weeks from the onset of the attack. The affected limbs show less development as the patient grows older, and the deformity is usually most marked in the leg. The reaction of degeneration is present in the atrophied muscles. Early in the course the muscles lose the faradic response.

Prognosis.—The mortality is low, ranging in different epidemics from 4 to 15 per cent. The fatal cases are usually of the ascending, bulbar and meningeal types. As regards the muscles, complete loss of response to faradism means severe atrophy. If it is never completely lost the outlook is good.

Prophylaxis.—The disease has been made notifiable. The patient should be isolated, the discharges and articles used by patients and nurses carefully disinfected, and special care should be taken of the nasal and pharyngeal discharges. It does not seem necessary to enforce a quarantine against those who come into relation with the patients, but the throat and nose of such persons should be disinfected with a menthol spray. There is some warrant for the administration of prophylactic doses of hexamethylenamine.

Treatment.—Unfortunately we possess at present no drug that is capable of acting directly upon the poison in the central nervous system. The interesting observations of Cushing and Crowe on the elimination of hexamethylenamine into the subdural space have suggested the use of this drug, and experimentally it has been shown by Flexner to delay or even to prevent the onset of the disease when inoculated into monkeys. It should be given freely in doses of grs. v to xv (0.3 to 1 gm.).

When the fever is high the general treatment is that of an acute infection. Aspirin and sedatives for the pain may be given. Lumbar puncture has been advised, and if the pressure is found to be high it should be repeated. The affected limb should be wrapped in cotton wool, and, if there is much pain, local sedative applications may be used. In the meningeal type of the disease warm baths and hot packs will be helpful. In the early stages it is well not to attempt to do much to the muscles, but within ten days careful massage may be practiced, using either lanolin or sweet oil. Strychnine hypodermically has been extensively used, but how far it has any influence may be questioned. It should not be given early. Electricity may be used and it has a value in keeping up the nutrition of the muscles. The faradic current should be employed if there is response, if not, the galvanic. The damage always looks to be much worse than it really is, as many of the symptoms depend on meningeal and vascular changes which undergo resolution. A curative serum has not yet been obtained, though the possibility is in sight, since we know that the blood serum from human beings and monkeys after recovery may prevent the development of paralysis following the experimental inoculation of the virus. The patients should be seen early by the orthopedic surgeon, as much may be done to prevent deformities.

XII. HYDROPHOBIA

(*Lyssa; Rabies*)

Definition.—An acute disease of warm-blooded animals, dependent upon a virus which is communicated by inoculation to man.

Distribution.—Rabies is very variously distributed. In Russia it is common. In North Germany it is relatively rare, owing to the wise provision that all dogs must be muzzled. In France it is much more common. In England the muzzling order has been followed by a complete disappearance of the disease and there has been no death from hydrophobia since 1903. In the decennium ending with 1890 the deaths averaged 29 annually (Tatham). In the United States the disease occurs more often than is generally supposed.

Etiology.—Dogs are especially liable to the disease. It also occurs in

complaints by the mechanic. Two cases with otherwise
[illegible]
accidents of nose throat should be destroyed.
discovery & isolation of bacilli

acute stage:
watch bladder. retention & stasis.
pain - opium in some form. - heat locally.
diet. fluid. donot push.
local = fixation of articulations & bracing -
fomites of limbs watched - so that unaffected muscles donot cause subluxation
slight volunteering movements. of par muscles are important early.
Par. sis. electricity - 3-8 weeks from onset. Galvanism on nerve trunks.
[illegible] ion to muscles as long as they respond. Ygdo not treat
use make & break galvanic.

serum - effective in some cases
hexamine - seems of value sometimes
IV. Tendencies - to dissociation symptoms & manifestations
more. weak. more common than paralyses
fatigue tend- arm's walking for years - in some cases 3 mos - 12 in others.
ency. doubtful. Muscle training most important - so accessible diagnosis &
knowledge of functional anatomy nec

Do better with out weight bearing exercises.

1 death in 1911 - (only 3 deaths 1901 ~ 1915)

The river becoming tranquil,

the wolf, fox, skunk, cat, horse and cow. Most animals are susceptible; and it is communicable by inoculation to the rabbit and pig. The disease is propagated chiefly by the dog. The nature of the poison is as yet unknown. It is contained chiefly in the nervous system and is met with in some of the secretions, particularly in the saliva. Bartarelli has shown that the virus reaches the dog's salivary glands by way of the nerves and not through the blood-vessels.

A variable time elapses between the introduction of the virus and the appearance of the symptoms. Horsley states that this depends upon the following factors: "(*a*) Age. The incubation is shorter in children than in adults. For obvious reasons the former are more frequently attacked. (*b*) Part infected. The rapidity of onset of the symptoms is greatly determined by the part of the body which may happen to have been bitten. Wounds about the face and head are especially dangerous; next in order in degrees of mortality come bites on the hands, then injuries on the other parts of the body. This relative order is, no doubt, greatly dependent upon the fact that the face, head, and hands are usually naked, while the other parts are clothed; it would also appear to depend somewhat upon the richness in nerves of the part. (*c*) The extent and severity of the wound. Puncture wounds are the most dangerous; the lacerations are fatal in proportion to the extent of the surface afforded for absorption of the virus. (*d*) The animal conveying the infection. In order of decreasing severity come: first, the wolf; second, the cat; third, the dog; and fourth, other animals." Only a limited number of those bitten by rabid dogs become affected by the disease; according to Horsley, not more than 15 per cent. On the other hand, the death-rate of those persons bitten by wolves is higher, not less than 40 per cent. Babes gives the mortality as from 60 to 80 per cent.

The incubation period in man is extremely variable. The average is from six weeks to two months. In a few cases it has been under two weeks. It may be prolonged to three months. It is stated that the incubation may be prolonged for a year or even two years, but this has not been definitely settled.

Morbid Anatomy.—The important lesions consist in the accumulation of leucocytes around the blood-vessels and the nerve-cells, particularly the motor ganglion cells, of the central nervous system (rabic tubercles of Babes). Especial importance in the rapid diagnosis of rabies is attached by van Gehuchten and Nelis to the accumulation of lymphoid and endothelioid cells around nerve-cells of the sympathetic and cerebro-spinal ganglia. Negri described in the central nervous system irregular bodies varying from 4 to 10 microns in size, widespread, frequently in the cells of the cerebellum, cerebral cortex and pons, and in the spinal cord. They are probably protozoa, and it is stated that they furnish a rapid and trustworthy means of diagnosis. The inoculation experiments show that the virus is not present in the liver, spleen, or kidneys, but is abundant in the spinal cord, brain, and peripheral nerves.

Symptoms.—Three stages of the disease are recognized:

(*a*) Premonitory stage, in which there may be irritation about the bite, pain, or numbness. The patient is depressed and melancholy; and complains of headache and loss of appetite. He is very irritable and sleepless, and has a constant sense of impending danger. There is often greatly increased sensibility. A bright light or a loud voice is distressing. The larynx may be injected, and the first symptoms of difficulty in swallowing are experienced.

~~The voice also becomes husky.~~ There is a slight rise in ~~the~~ temperature and ~~the~~ pulse.

(*b*) STAGE OF EXCITEMENT.—This is characterized by great excitability and restlessness, and an extreme degree of hyperæsthesia. "Any afferent stimulant—i. e., a sound or a draught of air, or the mere association of a verbal suggestion—will cause a violent reflex spasm. In man this symptom constitutes the most distressing feature of the malady. The spasms, which affect particularly the muscles of the larynx and mouth, are exceedingly painful and are accompanied by an intense sense of dyspnœa, even when the glottis is widely opened or tracheotomy has been performed" (Horsley). Any attempt to take water is followed by an intensely painful spasm of the muscles of the larynx and of the elevators of the hyoid bone. It is this which makes the patient dread the very sight of water and gives the name *hydrophobia* to the disease. These spasmodic attacks may be associated with maniacal symptoms. In the intervals the patient is quiet and the mind unclouded. The temperature in this stage is usually elevated and may reach from 100° to 103°. In some instances the disease is afebrile. The patient rarely attempts to injure his attendants, and in the intense spasms may be particularly anxious to avoid hurting any one. There are, however, occasional fits of furious mania, and the patient may, in the contractions of the muscles of the larynx and pharynx, give utterance to odd sounds. This stage lasts from a day and a half to three days and gradually passes into the—

(*c*) PARALYTIC STAGE.—In rodents the preliminary and furious stages are absent, as a rule, and the paralytic stage may be marked from the outset —the so-called dumb rabies. This stage rarely lasts longer than from six to eighteen hours. The patient then becomes quiet; the spasms no longer occur; unconsciousness gradually supervenes; the heart's action becomes more and more enfeebled, and death occurs by syncope.

Diagnosis.—In man the diagnosis offers no special difficulties. It is advisable, in cases attended with any doubts, as soon as possible after the injury has been inflicted, to secure the medulla oblongata of the supposed rabid animal for the purpose of inoculating rabbits. The subdural inoculation of rabbits with a small quantity of the central nervous system of a rabid animal will be followed by the occurrence of the paralytic form of the disease in from fifteen to twenty days.

Treatment.—Prophylaxis is of the greatest importance, and by a systematic muzzling of dogs the disease can be practically eradicated.

In case of a bite from a suspicious animal, bleeding should be encouraged, the wound freely opened and washed with bichloride of mercury solution (1 to 1,000). Thorough cauterization should be done as soon as possible, for which pure carbolic or nitric acid should be used, being applied to every part of the wound. The wound is washed with a saturated solution of bicarbonate of soda and then with alcohol. When once established the disease is hopelessly incurable. No measures have been found of the slightest avail, consequently the treatment must be palliative. The patient should be kept in a darkened room, in charge of not more than two attendants. To allay the spasm, chloroform may be administered and morphia given hypodermically. It is best to use these powerful remedies from the outset, and not to temporize with chloral, bromide of potassium, and other less potent drugs. By

making ointments and - note from Med Medicine

1915. 2151 deaths

2276 deaths under age of 20 from acute pericarditis & endocarditis

the local application of cocaine, the sensitiveness of the throat may be diminished sufficiently to enable the patient to take liquid nourishment. Sometimes he can swallow readily. Nutrient enemata should be administered.

PREVENTIVE INOCULATION.—Pasteur found that the virus, when propagated through a series of rabbits, increases in its virulence; so that whereas subdural inoculation of the brain of a mad dog takes from fifteen to twenty days to produce the disease, in successive inoculation in a series of rabbits the incubation period is gradually reduced to seven days (*virus fixe*). The spinal cords of these rabbits contain the virus in great intensity, but when they are preserved in dry air this gradually diminishes. If now dogs are inoculated from cords preserved for from twelve to fifteen days, and then from cords preserved for a shorter period, i. e., with a progressively stronger virus, they gradually acquire immunity against the disease. A dog treated in this way will resist inoculation with the *virus fixe*, which otherwise would inevitably have proved fatal. Relying upon these experiments, Pasteur began inoculations in the human subject, using, on successive days, material from cords in which the virus was of varying degrees of intensity.

In 1910, 410 patients were treated at the Pasteur Institute of Paris without a death; in 1909, 467 cases and one death, in 1908, 524 cases and one death. There has been a progressive decline in the number of cases and in the mortality.

Pseudo-hydrophobia (*Lyssophobia*).—This ~~is a very interesting affection, which~~ may closely resemble hydrophobia, but is really nothing more than a neurotic or hysterical manifestation. A nervous person bitten by a dog, either rabid or supposed to be rabid, has within a few months, or even later, symptoms somewhat resembling the true disease. He is irritable and depressed. He constantly declares his condition to be serious and that he will inevitably become mad. He may have paroxysms in which he says he is unable to drink, grasps at his throat, and becomes emotional. The temperature is not elevated and the disease does not progress. It lasts much longer than the true rabies, and is amenable to treatment. It is not improbable that a majority of the cases of alleged recovery in this disease have been of this hysterical form. Certain cases of acute bulbar paralysis may resemble hydrophobia, and, as already mentioned, there is a form of tetanus with hydrophobic symptoms.

XIII. RHEUMATIC FEVER

Definition.—An acute infection, dependent upon an unknown infective agent, and characterized by multiple arthritis and a marked tendency to inflammation of the endocardium of the valves of the heart.

Etiology.—DISTRIBUTION AND PREVALENCE.—It prevails in temperate and humid climates. Church has collected interesting statistics on this point. Oddly enough, the two countries with the highest admission in the British army per thousand of strength—Egypt, 7.02, and Canada, 6.26—have climates the most diverse. In the Registrar General's report for England and Wales for 1909 there were 1,970 deaths from the disease, but rheumatic fever has a long arm and no small proportion of the 50,918 deaths from diseases of the heart is to be laid at its door. The disease prevails more in the northern lati-

tudes. In the Montreal General Hospital there were, for the twelve years ending 1903, 2 deaths in 482 cases among 12,044 admissions; at the Royal Victoria Hospital, Montreal, for ten years ending 1903, 3 deaths in 285 cases among 9,286 admissions (John McCrae). At the Johns Hopkins Hospital for the fifteen years ending 1904 there were 360 admissions (330 patients) and 9 deaths (T. McCrae)). The general impression is that the disease prevails more in the British Isles than elsewhere; but, as Church remarks, the returns are very imperfect (this holds good everywhere). In Norway, where cases of rheumatic fever are notified, there were, for the four years 1888-'92, 13,654 cases, with 250 deaths.

Season.—In London the cases reach the maximum in the months of September and October. In the Montreal General Hospital Bell's statistics of 456 cases show that the largest number was admitted in February, March, and April. And the same is true in Baltimore; 55 per cent. of our cases were admitted in the first four months of the year (McCrae). The disease prevails most in the dry years or a succession of such, and is specially prevalent when the subsoil water is abnormally low and the temperature of the earth high (Newsholme).

Age.—Young adults are most frequently affected, but the disease is by no means uncommon in children. In England the incidence in children is very high. In 2,556 examined by Langmead, 133 were definitely rheumatic and in all but 18 the heart was involved. In 43 per cent. of these cases there was some abnormality of the tonsils or pharyngeal mucosa. Sucklings are rarely attacked. Milton Miller has analyzed 19 undoubted cases. The cases have to be distinguished from a totally different affection, the pyogenic arthritis of infants. Of 456 cases admitted to the Montreal General Hospital there were, under fifteen years, 4.38 per cent.; from fifteen to twenty-five years, 48.68 per cent.; from twenty-five to thirty-five years, 25.87 per cent.; from thirty-five to forty-five years, 13.6 per cent.; above forty-five years, 7.4 per cent. Of our 360 admissions, 110 were in the third decade and 65 per cent. below the thirtieth year of age (McCrae). Ten per cent. of the cases had the first attack in the first decade. Of the 655 cases analyzed by Whipham for the Collective Investigation Committee of the British Medical Association, only 32 cases occurred under the tenth year and 80 per cent. between the twentieth and fortieth years. These figures do not give the ratio of cases in children, in whom the milder types of arthritis are very common.

Sex.—If all ages are taken, males are affected oftener than females. Of our patients, 239 were males, 91 females. In the Collective Investigation Report there were 375 males and 279 females. Up to the age of twenty, however, females predominate. Between the ages of ten and fifteen girls are more prone to the disease.

Heredity.—It is a deeply grounded belief with the public and the profession that rheumatism is a family disease, but ~~Church thinks~~ the evidence is ~~still~~ imperfect. In 25 per cent. of our cases there was a history of the disease in the family. The not rare occurrence in several members of the same family is used by those who believe in the infectious origin as an argument in favor of its being a house disease.

Chill.—Exposure to cold, a wetting, or a sudden change of temperature

are among the factors in determining the onset of an attack, but they were present in only 12 per cent. of our cases.

Not only does an attack not confer IMMUNITY, but, as in pneumonia, predisposes the subject to the disease.

Rheumatic Fever as an Acute Infectious Disease.—Rheumatic fever, as Newsholme has shown, has epidemic prevalence with irregular periodicity, recurring at intervals of three, four, or six years, and varying much in intensity. A severe epidemic is usually followed by two or three years of slight prevalence.

The disease has many features suggestive of septic infection. As Church points out, the curves of the mortality statistics approximate nearly to those of pyæmia, puerperal fever, and erysipelas. In the character of the fever, the mode of involvement of the joints, the tendency to relapse, the sweats, the anæmia, the leucocytosis, and, above all, in the great liability to endocarditis, and to involvement of the serous membranes, the disease resembles pyæmia very closely.

The nature of the specific germ is still under discussion. Mantle in 1887 obtained a micrococcus from the fluid of the joints and from the blood; since which time many observers have described forms of staphylococci, streptococci and various organisms. The work of Poynton and Payne, Walker, Beattie and others shows that from the joint fluid, the throat and the endocardial vegetations, and sometimes from the blood, organisms may be obtained which, inoculated into animals, cause a condition very similar to that of acute rheumatic fever, with arthritis, endocarditis, and even the fibrous nodules. The difficulty is that the organisms described do not coincide, and Cole in a series of cases in my clinic at the Johns Hopkins Hospital with the strains of streptococci from various sources was able to produce experimentally endocarditis and arthritis. But Beattie claims that the lesions produced by his *Micrococcus rheumaticus* are different. A point of interest is the fact that with his germ Ainley Walker obtained formic acid in the cultures.

The tonsils are culture centres for many septic organisms, particularly of the streptococcus type. The association of rheumatic fever and rheumatic affections generally with infected tonsils is a prevailing view, but it is an old story insisted on by Lasague and other French writers years ago. A not inconsiderable number of cases of rheumatic fever begin with tonsillitis. With organisms isolated from the tonsils experimental arthritis and endocarditis have been caused. The removal of the tonsils has been followed by a complete recovery of sub-acute and chronic forms of arthritis. This is as far as the evidence goes.

There is considerable evidence against the view that it is simply a mild pyogenic infection. Salicylates have no effect on the ordinary streptococcus infections, and the clinical course in the streptococcus arthritis is very different; moreover, rheumatic joints never suppurate. The isolation of streptococci may simply indicate the presence of secondary invaders such as occur in scarlet fever and small-pox.

Morbid Anatomy.—There are no characteristic changes. The affected joints show hyperæmia and swelling of the synovial membranes and of the ligamentous tissues. The fluid in the joint is turbid, albuminous in char-

acter, and contains leucocytes and a few fibrin flakes. Rheumatic fever rarely proves fatal, except when there are serious complications, such as pericarditis, endocarditis, myocarditis, pleurisy, or pneumonia. The conditions found show nothing to distinguish them from other forms of inflammation. In death from hyperpyrexia no special changes are found. The blood usually contains an excessive amount of fibrin.

Symptoms.—As a rule, the disease sets in abruptly, but it may be preceded by irregular pains in the joints, slight *malaise*, sore throat, and particularly by tonsillitis. A definite rigor is uncommon; more often there is slight chilliness. The fever rises quickly, and with it one or more of the joints become painful. Within twenty-four hours from the onset the disease is fully manifest. The temperature range is from 102° to 104°. The pulse is frequent, soft, and usually above 100. The tongue is moist, and rapidly becomes covered with a white fur. There are the ordinary symptoms associated with an acute fever, such as loss of appetite, thirst, constipation, and a scanty, highly acid, highly colored urine. In a majority of the cases there are profuse, very acid sweats, of a peculiar sour odor. Sudaminal and miliary vesicles are abundant, the latter usually surrounded by a minute ring of hyperæmia. The mind is clear, except in the cases with hyperpyrexia. The affected joints are painful to move, soon become swollen and hot, and present a reddish flush. The order of frequency of involvement of the joints in our series was knee, ankle, shoulder, wrist, elbow, hip, hand, foot. The joints are not attacked together, but successively. For example, if the knee is first affected, the redness may disappear from it as the wrists become painful and hot. The disease is seldom limited to a single articulation. The amount of swelling is variable. Extensive effusion into a joint is rare, and much of the enlargement is due to the infiltration of the periarticular tissues with serum. The swelling may be limited to the joint proper, but in the wrists and ankles it sometimes involves the sheaths of the tendons and produces great enlargement of the hands and feet. Corresponding joints are often affected. In attacks of great severity every one of the larger joints may be involved. The vertebral, sterno-clavicular, and phalangeal articulations are less often inflamed than in gonorrhœal arthritis. Perhaps no disease is more painful; the inability to change the posture without agonizing pain, the drenching sweats, the prostration and utter helplessness, combine to make it one of the most distressing of febrile affections. A special feature is the tendency of the inflammation to subside in one joint while increasing with great intensity in another.

The temperature range in an ordinary attack is between 102° and 104° F. In only 18 of our cases did the temperature rise above 104° F. In 100 it reached 103° F. or over. It is peculiarly irregular, with marked remissions and exacerbations, and defervescence is usually gradual. The profuse sweats materially influence the temperature curve. If a two-hourly chart is made and observations upon the sweats are noted, the remissions will usually be found coincident with them. The perspiration is sour-smelling and acid at first; but, when persistent, becomes neutral or even alkaline.

The blood is profoundly altered and there is no acute febrile disease in which an anæmia occurs with greater rapidity. The average leucocyte count in our cases was about 12,000 per c. mm.

With the high fever a murmur may often be heard at the apex region. Endocarditis is also a common cause of an apex *bruit*. The heart should be carefully examined at the first visit and subsequently each day.

The urine is, as a rule, reduced in amount, of high density and high color. It is very acid, and, on cooling, deposits urates. The chlorides may be greatly diminished or even absent. Formic acid is present (Walker). Febrile albuminuria is not uncommon.

The so-called *subacute rheumatism* represents a milder form of the disease, in which all the symptoms are less pronounced. The fever rarely rises above 101°; fewer joints are involved; and the arthritis is less intense. The cases may drag on for weeks or months. It should not be forgotten that this mild or subacute form may be associated with endocarditis or pericarditis.

The influence of age on the manifestations of the disease is marked. While the usual description applies to the disease as seen in adults, in young children there may not be any pronounced arthritis, and the discovery of endocarditis often suggests the diagnosis. Endocarditis is as much a feature in children as arthritis in adults.

Complications.—These are important and serious.

(*a*) Hyperpyrexia.—The temperature may rise rapidly a few days after the onset, and be associated with delirium; but not necessarily, for the temperature may rise to 108° or, as in one of Da Costa's cases, 110°, without cerebral symptoms. Hyperpyrexia is most common in first attacks, 57 of 107 cases (Church). It is most apt to occur during the second week. Delirium may precede or follow its onset. As a rule, with the high fever, the pulse is feeble and frequent, the prostration is extreme, and finally stupor supervenes. In our series there was no instance of hyperpyrexia, which seems rare in the United States.

(*b*) Cardiac Affections.—(1) *Endocarditis,* the most frequent and serious complication, occurs in a considerable percentage of all cases. Of 889 cases, 494 had signs of old or recent endocarditis (Church). The liability to endocarditis diminishes as age advances. The incidence of organic disease in our cases was more than double in patients who had their first attack before the age of twenty years, compared with those with the first attack after twenty years of age. It increases directly with the number of attacks. Of 116 cases, in the first attack 58.1 per cent. had endocarditis, 63 per cent. in the second attack, and 71 per cent. in the third attack (Stephen Mackenzie). Thirty-five per cent. of our cases showed organic valve lesions, in 96 per cent. the mitral was involved, in 27 per cent. the aortic, and in 23 per cent. the lesions were combined. The mitral segments are most frequently involved and the affection is usually of the simple, verrucose variety. Ulcerative endocarditis is very rare. Of 209 cases of this disease which I analyzed, in only 24 did the symptoms of a severe endocarditis arise during the progress of acute or subacute rheumatism. The valvulitis in itself is rarely dangerous, producing few symptoms, and is often overlooked. Unhappily, though the valve at the time may not be seriously damaged, the inflammation starts changes which lead to sclerosis and retraction of the segments, and so to chronic valvular disease. Venous thrombosis is an occasional complication.

(2) *Pericarditis* may occur independently of or together with endocarditis. It may be simple fibrinous, sero-fibrinous, or in children purulent

Clinically we meet it more frequently in connection with this disease than in any other acute affection. It was present in 20 cases of our series—6 per cent.—in only four of which did effusion occur. The physical signs are very characteristic. The condition will be fully described under its appropriate section. A peculiar form of delirium may accompany rheumatic pericarditis.

(3) *Myocarditis* occurs frequently and especially in connection with endo-pericardial changes. As Sturges insisted, the term *carditis* is applicable to many cases. The anatomical condition is a granular or fatty degeneration of the heart-muscle, which leads to weakening of the walls and to dilatation. S. West has reported instances of acute dilatation of the heart in rheumatic fever, in one of which marked fatty changes were found in the heart-fibres.

(*c*) Pulmonary Affections.—Pneumonia and pleurisy occurred in 9.94 per cent. of 3,433 cases (Stephen Mackenzie). They frequently accompany the cases of endo-pericarditis. According to Howard's analysis of a large number of cases, there were pulmonary complications in only 10.5 per cent. of cases of rheumatic endocarditis; in 58 per cent. of cases of pericarditis; and in 71 per cent. of cases of endo-pericarditis. Congestion of the lung is occasionally found, and in several cases has proved rapidly fatal.

(*d*) Nervous Complications.—These are due, in part, to the hyperpyrexia and in part to the special action of the toxic agent of the disease. They may be grouped as follows: (*i*) *Cerebral rheumatism,* as it is called, which is characterized by (α) *Delirium,* which is associated with the hyperpyrexia or the toxæmia, may be active and noisy in character; more rarely it is a low, muttering delirium, passing into stupor and coma. It may be excited by the salicylate of soda, either shortly after its administration, or more commonly a few days later. It was present in only five of our 360 cases, and in four of these we thought the salicylates at fault. A peculiar delirium occurs in connection with rheumatic pericarditis. (β) Coma, which is more serious, may occur without preliminary delirium or convulsions, and may prove rapidly fatal. Certain of these cases are associated with hyperpyrexia; but Southey has reported the case of a girl who, without previous delirium or high fever, became comatose, and died in less than an hour. A certain number of such cases, as those reported by Da Costa, have been associated with marked renal changes and were evidently uræmic. The coma may supervene during the attack, or after convalescence has set in. (γ) *Convulsions* are less common, though they may precede the coma. Of 127 observations cited by Besnier, there were 37 of delirium, only 7 of convulsions, 17 of coma and convulsions, 54 of delirium, coma, and convulsions, and 3 of other varieties (Howard). "Cerebral rheumatism" is a very serious complication; among 107 cases collected by the Clinical Society of London there were 57 deaths. (*ii*) *Chorea.* The relations of this disease and rheumatism will be subsequently discussed. It is sufficient here to say that in only 88 out of 554 cases which I have analyzed from the Infirmary for Diseases of the Nervous System, Philadelphia, were chorea and rheumatism associated. It is most apt to develop in the slighter attacks in childhood. (*iii*) *Meningitis* is extremely rare, though undoubtedly it does occur. It must not be forgotten that in ulcerative endocarditis, which is occasionally associated with rheumatic fever, meningitis is frequent. (*iv*) *Polyneuritis* has been described. I saw a remarkable case

which followed hyperpyrexia. Free venesection saved the patient's life. After many months the patient recovered, but with ataxia.

(*e*) Cutaneous Affections.—Sweat-vesicles have already been mentioned as extremely common. A red miliary rash may also develop. Scarlatiniform eruptions are occasionally seen. Purpura, with or without urticaria, may occur, and various forms of erythema. It is doubtful whether the cases of extensive purpura with urticaria and arthritis—peliosis rheumatica—belong truly to rheumatic fever.

(*f*) Rheumatic Nodules.—These curious structures, described originally by Meynet, occur in the form of small subcutaneous nodules attached to the tendons and fasciæ. Barlow and Warner, in England, and T. B. Futcher, in the United States, have paid special attention to their varieties and importance. They vary in size from a small shot to a large pea, and are most numerous on the fingers, hands, and wrists. They also occur about the elbows, knees, the spines of the vertebræ, and the scapulæ. They are not often tender. They are more common after the decline of the fever and in the children with mitral valve disease. In only 5 of our patients were they present during the acute attack. The nodules may grow with great rapidity and usually last for weeks or months. They are more common in children than in adults, and in the former their presence may be regarded as a positive indication of rheumatism. They have been noted particularly in association with chronic rheumatic endocarditis. Subcutaneous nodules occur also in migraine, gout, and arthritis deformans. Histologically they are made up of round and spindle-shaped cells. In addition to these firm, hard nodules, there occur in rheumatism and in chronic vegetative endocarditis remarkable bodies, which have been called by Féréol "nodosités cutanées éphémères."

Course.—The *course* of rheumatic fever is extremely variable. It is, as Austin Flint first showed, a self-limited disease, and it is not probable that ~~medicines~~ have any special influence upon its *duration* or *course*. Gull and Sutton, who ~~likewise~~ studied a series of 62 cases without special treatment, arrived at the same conclusion.

Prognosis.—Rheumatic fever is the most serious of all diseases with a low death-rate. The mortality is rarely above 2 or 3 per cent. Only 9 of our 330 patients died, 2.7 per cent., all with endocarditis and 6 with pericarditis.

Sudden death in rheumatic fever is due most frequently to myocarditis. Herringham has reported a case in which on the fourteenth day there was fatty degeneration and acute inflammation of the myocardium. In a few rare cases it results from embolism. Alarming symptoms of depression sometimes follow excessive doses of the salicylate of soda.

Diagnosis.—Practically, the recognition of rheumatic fever is usually easy; but there are several affections which, in some particulars, closely resemble it.

(*a*) Multiple Secondary Arthritis.—Under this term may be embraced the various forms of arthritis which ~~come on~~ or follow ~~in the course of~~ gonorrhœa, tonsillitis, scarlet fever, dysentery, and cerebro-spinal meningitis.

(*b*) Septic Arthritis, which occurs in the course of pyæmia from any cause, and particularly in puerperal fever. No hard and fast line can be drawn between these and the cases in the first group: but the inflammation rapidly passes on to suppuration and there is more or less destruc-

tion of the joints. The conditions under which the arthritis occurs give a clew at once to the nature of the case. Under this section may also be mentioned:

(1) *Acute necrosis* or *acute osteo-myelitis*, occurring in the lower end of the femur, or in the tibia, and which may be mistaken for rheumatic fever. Sometimes, too, it is multiple. The greater intensity of the local symptoms, the involvement of the epiphyses rather than the joints, and the more serious constitutional disturbances are points to be considered. The condition is unfortunately often mistaken for acute arthritis, and, as the treatment is essentially surgical, the error may cost the life of the patient.

(2) *The acute arthritis of infants* is usually confined to one joint (the hip or knee), the effusion in which rapidly becomes purulent. The affection is most common in sucklings and undoubtedly pyæmic in character. It may also occur with the gonorrhœal ophthalmia or vaginitis of the new-born, as pointed out by Clement Lucas.

(*c*) Gout.—While the localization in a single, usually a small, joint, the age, the history, and the mode of onset are features which enable us to recognize acute gout, there are everywhere many cases of acute arthritis, called rheumatic fever, which are in reality gout. The involvement of several of the larger joints is not so infrequent in gout, and unless tophi are present, or unless a very accurate analysis of the urine is made, the diagnosis may be difficult.

(*d*) Acute Arthritis Deformans.—In several cases I have mistaken this form for rheumatic fever. It may come on with fever and multiple arthritis, and for weeks there may be no suspicion of the true nature of the disease. Gradually the fever subsides, but the periarticular thickening persists. As a rule, however, in the acute febrile cases the involvement of the smaller joints, the persistence and the early changes in the articulations suggest arthritis deformans.

In children the diagnosis may be very difficult, as arthritis may be slight or entirely absent. The possibility of rheumatic fever should be considered in all febrile attacks in children for which no definite cause can be found. Special care should be given to the examination of the heart.

Treatment.—The main object should be to bring the patient through the attack with an undamaged heart or with as little injury as possible. The first essential is complete rest, which should be begun at once and insisted upon for as long as is necessary. This is especially important for children. The bed should have a smooth, soft, yet elastic, mattress. The patient should wear a flannel nightgown, which may be opened all the way down the front and slit along the outer margin of the sleeves. Three or four of these should be made, so as to facilitate the frequent changes required after the sweats. He may wear also a light flannel cape about the shoulders. He should sleep in blankets, not in sheets, so as to reduce the liability to catch cold and obviate the unpleasant clamminess consequent upon heavy sweating. Chambers insisted that the liability to endocarditis and pericarditis was much reduced when the patients were in blankets.

Milk is the most suitable diet and may be diluted with alkaline mineral waters. Lemonade and oatmeal or barley water should be freely given. The thirst is usually great and may be fully satisfied. There is no objection to

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broths and soups if the milk is not well borne. As convalescence is established a fuller diet may be allowed, but meat should be used sparingly.

Local treatment is usually necessary. It often suffices to wrap the affected joints in cotton. If the pain is severe, hot cloths may be applied, saturated with Fuller's lotion (carbonate of soda, 6 drachms; laudanum, 1 oz.; glycerine, 2 oz.; and water, 9 oz.) or the lead and opium lotion. Oil of wintergreen is useful, the joint being gently rubbed with it or small amounts sprinkled over flannel, which is then applied. Chloroform liniment is also a good application. Fixation of the joints is of great service in allaying the pain. Splints, padded and bandaged with moderate firmness, will often be found to give comfort. Friction is rarely well borne in an acutely inflamed joint. Cold compresses are much used in Germany. The application of blisters above and below the joint often relieves the pain. This method, which was used so much a few years ago, is not to be compared with the light application of the Paquelin cautery. If there is much effusion, aspiration of the joint is useful.

The drug treatment is still far from satisfactory, though the introduction of the salicyl compounds has been a great boon.

Treatment with the Salicyl Compounds.—Salicin, introduced in 1876 by Maclagan, may be used in doses of 20 grains every hour or two until the pain is relieved. It has the advantage of being less depressing than the salicylate of soda. It is also perhaps the best drug to use for children. ~~Salicylic acid, 15 grains (1 gm.), may be given every two hours in acute cases until the pain is relieved.~~ It ~~is best given in capsules~~. Salicylate of soda, 15 grain doses every three hours, is perhaps the best for general use in adults. After the pain has been relieved, the drug should be given every four or five hours until the temperature begins to fall. ~~The~~ potassium bicarbonate may or sodium be given with it. Oil of wintergreen, 20 minims every two hours in milk, or aspirin (gr. xv, 1 gm.), may be used if the salicylate of soda disagrees. There are many other salicyl compounds, but the best results are obtained from the use of ~~one or the other of the above-named preparations~~. There can be no question as to their efficacy in relieving the pain. Some observers consider that they also protect the heart, shorten the course, and render relapse less likely. Sod. sal

The Alkaline Treatment.—The urine should be rendered alkaline as soon as possible. Potassium acetate and citrate in doses of 15 grains (1 gm.) each are given every three hours until the urine is alkaline and then often enough to keep it so. Potassium bicarbonate may be given in half-drachm doses every three hours with the salicylic ~~acid or salicin~~. Fuller's plan was Sod. to give a drachm and a half of sodium bicarbonate with half a drachm of potassium acetate in three ounces of water, rendered effervescent at the time of administration by half a drachm of citric acid or an ounce of lemon-juice.

A widespread popular belief attributes marvelous efficacy to bee-stings in all sorts of rheumatism, and a formic-acid treatment has been introduced. A 2½ per cent. solution is injected in the neighborhood of the painful joints. Ainley Walker has collected (B. M. J., October 10, 1908) an interesting literature on the subject.

To allay the pain opium may be given in the form of Dover's powder, or morphia hypodermically. Antipyrin, antifebrin, and phenacetin are useful sometimes for the purpose. During convalescence iron is indicated in full doses, and quinine is a useful tonic. Of the complications, hyperpyrexia

should be treated by the cold bath or the cold pack. The treatment of endocarditis and pericarditis and the pulmonary complications will be considered under their respective sections. In all the cardiac complications the importance of prolonged rest must be remembered.

To prevent and arrest endocarditis Caton urges the use of a series of small blisters along the course of the third, fourth, fifth, and sixth intercostal nerves of the left side, applied one at a time and repeated at different points. Potassium or sodium iodide is given in addition to the salicylates. The patients are kept in bed for about six weeks.

Tonsils.—With disease of these and the possibility that they are the portals of entry for the infective agent, the question arises as to their removal. In patients with diseased tonsils in whom rheumatic fever has occurred removal is advisable and should ~~always~~ be complete. In patients with endocarditis and fever this may be done apparently without risk. It is comparable to the removal of any local focus of infection which is causing general symptoms.

XIV. ACUTE TONSILLITIS

Definition.—An acute infection, sporadic or epidemic, involving the structures of the tonsillar ring, usually due to organisms of the streptococcus class.

Etiology.—Acute tonsillitis occurs in sporadic and epidemic forms. The sporadic variety, one of the most common of diseases, is met with in young persons particularly at the school age. Infants are rarely attacked. Chronic enlargement of the lymphatic structures of the throat is an important predisposing cause. Exposure to cold and wet may bring on an attack. It is directly communicated from one child to another. A not infrequent precursor of rheumatic fever, Cheadle ~~very properly~~ described it as one link in the rheumatic chain. It may be directly followed by endocarditis, erythema nodosum, chorea, and acute nephritis. In Great Britain it prevails in the autumn months, in the United States in the spring. An old notion held that there was a close relation between the tonsils and the testes and ovaries, and F. J. Shepherd ~~has~~ called attention to the frequency of acute tonsillitis in newly married persons.

Epidemic tonsillitis is not infrequent, the cases increasing in the community to epidemic proportions. As a rule it is impossible to trace it to any special cause. There are remarkable localized outbreaks, sometimes in institutions, which have been traced to milk infection. The ~~recent~~ one in Boston (1911) was exceptionally severe, involving more than 1,000 persons, and the connection with the use of the milk from one dairy seems to have been clearly traced. More females than males were attacked, and a large proportion of the cases were adults.

The bacteriology of both forms has been carefully studied. The tonsils, swarming with saprophytic and pathogenic germs, are the main gates through which the invaders try to storm the town. Normally the protecting forces suffice to keep them at bay, but now and again a fiercer battle than usual rages, barricades have to be set up in the shape of exudates and necroses—and a local tonsillitis is the outward and visible sign of the struggle. Too often the enemy gains entrance, and streptococci, staphylococci, pneumococci, etc.,

Ofcdmwl, 'n tr ...

pass to distant parts and excite arthritis, endocarditis, and serous membrane inflammations. In the recent Boston epidemic the streptococcus was the common germ, and the same holds good in the sporadic cases.

Morbid Anatomy.—The lacunæ of the tonsils become filled with exudation products, which form cheesy-looking masses, projecting from the orifices of the crypts. Not infrequently the exudations from contiguous lacunæ coalesce. The intervening mucosa is usually swollen, deep red in color, and may present herpetic vesicles, or, in some instances, even membranous exudation, in which case it may be difficult to distinguish the condition from diphtheria. The creamy contents of the crypt are made up of micrococci and epithelial débris.

Symptoms.—Chilly feelings, or even a definite chill, and aching pains in the back and limbs may precede the onset. The fever rises rapidly and in the case of a young child may reach 105° F. on the evening of the first day. The patient complains of soreness of the throat and difficuty in swallowing. On examination the tonsils are seen to be swollen and the crypts present the characteristic creamy exudate. The tongue is furred, the breath is heavy and foul, and the urine is highly colored and loaded with urates. In children the respirations are usually very hurried and the pulse is greatly increased in rapidity. Swallowing is painful and the voice often becomes nasal. Slight swelling of the cervical glands is present.

In epidemic cases the fever may be very high, the secondary enlargement of the glands considerable, and even the deeper tissues may be involved. The complications are very serious: endocarditis, pericarditis, pneumococcic peritonitis, and pneumonia. In the Boston epidemic the clinical sequence was not unlike that seen in rheumatic fever—sore throat, adenitis, multiple arthritis, endocarditis, and pneumonia. Febrile albuminuria is common and in a few cases acute nephritis follows. A diffuse erythema may simulate scarlet fever. Acute otitis media is a frequent complication in children. Relapses are not uncommon and the tonsils may remain enlarged.

In the sporadic and mild epidemic form it is rare to see a fatal case, but in severe outbreaks the mortality from complications may be three or four per cent. There were about 50 deaths in the Boston epidemic.

Occasionally paralyses follow the streptococcus tonsillitis which are identical with those of diphtheria.

Diagnosis.—It may be difficult to distinguish tonsillitis from diphtheria. It would seem, indeed, as if there were intermediate forms between the milder lacunar and the severer pseudo-membranous tonsillitis. In the follicular form, the individual yellowish-gray masses, separated by the reddish tonsillar tissue, are very characteristic; whereas in diphtheria the membrane is ashy-gray and uniform, not patchy. A point of the greatest importance in diphtheria is that the membrane is not limited to the tonsils, but creeps up the pillars of the fauces and appears on the uvula. The diphtheritic membrane, when removed, leaves a bleeding, eroded surface; whereas the exudation of lacunar tonsillitis is easily separated, and there is no erosion beneath it. In all doubtful cases cultures should be made to determine the presence or absence of Löffler's bacillus.

Treatment.—In the follicular form aconite may be given in full doses and it acts very beneficially in children. The salicylates, given freely at the outset,

are regarded by some as specific, but I have seen no evidence of such prompt and decisive action. At night a full dose of Dover's powder may be given. The use of guaiacum, in the form of 2-grain lozenges, is warmly recommended. Iron and quinine should be reserved until the fever has subsided. An ice-bag or cold compresses may be applied to the neck. Locally the tonsils may be treated with the dry sodium bicarbonate. The moistened finger-tip is dipped into the soda, which is then rubbed gently on the gland, and this is repeated every hour. Astringent preparations, such as iron and glycerine, alum, zinc, and nitrate of silver, may be tried. To cleanse and disinfect the throat, solutions of borax or thymol in glycerine and water may be used. In severe forms vaccines may be tried, prepared from the throat cultures, or, failing these, the ordinary anti-streptococcic serum.

XV. ACUTE CATARRHAL FEVER

(*Acute Coryza*)

Definition.—An acute infection of the mucous membrane of the upper air passages associated with the presence of the *Micrococcus catarrhalis* alone, or with other organisms.

Etiology.—The micrococcus described by R. Pfeiffer is a diplococcus with close resemblance to the meningococcus and the pneumococcus. It is a normal habitant of the throat and bronchial secretions of many persons. In acute inflammatory conditions of the upper air passages it is found, sometimes in almost pure culture, in the sputum. It is readily cultivated.

Prevailing most extensively in the changeable weather of the spring and early winter, coryza may occur in epidemic form, many cases arising in a community within a few weeks, outbreaks which are very like though less intense than the epidemic influenza. More often it is a local outbreak among the members of a house or of a school.

Symptoms.—The patient feels indisposed, perhaps chilly, has slight headache, and sneezes frequently. In severe cases there are pains in the back and limbs. There is usually slight fever, the temperature rising to 101° F. The pulse is quick, the skin is dry, and there are all the features of a feverish attack. At first the mucous membrane of the nose is swollen, "stuffed up," and the patient has to breathe through the mouth. A thin, clear, irritating secretion flows, and makes the edges of the nostrils sore. The mucous membrane of the tear-ducts is swollen, so that the eyes weep and the conjunctivæ are injected. The sense of smell and, in part, the sense of taste are lost. With the nasal catarrh there is slight soreness of the throat and stiffness of the neck; the pharynx looks red and swollen, and sometimes the act of swallowing is painful. The larynx also may be involved and the voice becomes husky or is even lost. If the inflammation extends to the Eustachian tubes the hearing may be impaired. In more severe cases there are bronchial irritation and cough. Occasionally there is an outbreak of labial or nasal herpes. Usually within thirty-six hours the nasal secretion becomes turbid and more profuse, the swelling of the mucosa subsides, the patient gradually becomes able to breathe through the nostrils, and within four or five days the symptoms dis-

appear, with the exception of the increased discharge from the nose and upper pharynx. There are rarely any bad effects from a simple coryza. When the attacks are frequently repeated the disease may become chronic.

Diagnosis.—The diagnosis is always easy, but caution must be exercised lest the initial catarrh of measles or severe influenza should be mistaken for the simple coryza.

Treatment.—Many attacks are so mild that the patients are able to be about and attend to their work. If there are fever and constitutional disturbance, the patient should be kept in bed and should take a simple fever mixture, and at night a drink of hot lemonade and a full dose of Dover's powder. Many persons find great benefit from the Turkish bath. For the distressing sense of tightness and pain over the frontal sinuses, cocaine is very useful and sometimes gives immediate relief. The 4-per-cent. solution may be injected into the nostrils or cotton wool soaked in it may be inserted into them. Later the snuff recommended by Ferrier is advantageous, composed of morphia (gr. ij), bismuth (ʒ iv), acacia powder (ʒ ij). This may occasionally be blown or snuffed into the nostrils. The fluid extract of hamamelis, "snuffed" from the hand every two or three hours, is much better.

A vaccine treatment has been introduced and may be tried in persons subject to recurring colds.

XVI. FEBRICULA—EPHEMERAL FEVER

Definition.—Fever of slight duration, probably depending upon a variety of causes, some autogenous, others extrinsic and bacterial.

A febrile paroxysm lasting for twenty-four hours and disappearing completely is spoken of as ephemeral fever. If it persists for three, four, or more days without local affection it is referred to as febricula.

The cases may be divided into several groups:

(*a*) Those which represent mild or abortive types of the infectious diseases. It is not very unusual, during an epidemic of typhoid, scarlet fever, or measles, to see patients with some of the prodromal symptoms and slight fever, which persist for two or three days without any distinctive features. Possibly, as Kahler suggests, some of the cases of transient fever are due to the rheumatic poison.

(*b*) In a larger and perhaps more important group of cases the symptoms develop with dyspepsia. In children indigestion and gastro-intestinal catarrh are often accompanied by fever. Possibly some instances of longer duration may be due to the absorption of certain toxic substances. Slight fever has been known to follow the eating of decomposing substances or the drinking of stale beer; but the gastric juice has remarkable antiseptic properties, and the frequency with which persons take from choice articles which are "high" shows that poisoning is not likely to occur unless there is existing gastro-intestinal disturbance.

(*c*) Cases which follow exposure to foul odors or sewer gas. That a febrile paroxysm may follow a prolonged exposure to noxious odors has long been recognized. The cases which have been described under this heading are of two kinds: an acute, severe form with nausea, vomiting, colic, and fever,

followed perhaps by a condition of collapse or coma; secondly, a form of low fever with or without chills. A good deal of doubt still exists in the minds of the profession about these cases of so-called sewer-gas poisoning. It is a notorious fact that workers in sewers are remarkably free from disease, and in many of the cases which have been reported the illness may have been only a coincidence. There are instances in which persons have been taken ill with vomiting and slight fever after exposure to the odor of a very offensive post mortem. Whether true or not, the idea is firmly implanted in the minds of the laity that very powerful odors from decomposing matters may produce sickness.

(*d*) Many cases doubtless depend upon slight unrecognized lesions, such as tonsillitis or occasionally an abortive or larval pneumonia. Children are much more frequently affected than adults.

The *symptoms* set in, as a rule, abruptly, though in some instances there may have been preliminary *malaise* and indisposition. Headache, loss of appetite, and furred tongue are present. The urine is scanty and high-colored, the fever ranges from 101° to 103°, sometimes in children it rises higher. The cheeks may be flushed and the patient has the outward manifestations of fever. In children there may be bronchial catarrh with slight cough. Herpes on the lips is a common symptom. Occasionally in children the cerebral symptoms are marked at the outset, and there may be irritation, restlessness, and nocturnal delirium. The fever terminates abruptly by crisis from the second to the fourth day; in some instances it may continue for a week.

The *diagnosis* generally rests upon the absence of local manifestations, particularly the characteristic skin rashes of the eruptive fevers, and, most important of all, the rapid disappearance of the pyrexia. The cases most readily recognized are those with acute gastro-intestinal disturbance.

The *treatment* is that of mild pyrexia—rest in bed, a laxative, and a fever mixture containing nitrate of potassium and sweet spirits of nitre.

XVII. INFECTIOUS JAUNDICE

(*Epidemic Catarrhal Jaundice; Weil's Disease*)

Local and widespread outbreaks of jaundice have been known for years. Three or four cases may occur in one house, or many persons in an institution are attacked, or the disease becomes widespread in a community. In Great Britain this epidemic form is rare. In the United States many outbreaks have occurred. It prevailed extensively in North Carolina in 1899-1900, and a fatal case of that epidemic came under my observation. In Syria, in Greece, in Egypt (Sandwith), in India (S. Anderson), and in South Africa during the Boer war (H. B. Matheas) epidemics have been described. It has prevailed most frequently in the summer months. The symptoms are at first gastric, then fever follows (with the usual concomitants) and jaundice, which may be slight or very intense, and as a rule albuminuria. The liver and spleen enlarge, and in severe forms there are nervous symptoms and hæmorrhages. There is often a secondary fever. The attack lasts from ten days to three weeks. The course is usually favorable; fatal cases are rare in

Spirochaeta found by Inada & Japanese observers.

S. icteric haemorrhagica. so-called

Spirochaetosis icterohaemorrhagica.

Weils disease.
Tr. with vaccines serum-sacha.
Serum from recovered human patients may cure human
disease only - usually during spirochaete is blood
Bulletin of W.H. in Japan 30-1570.

the United States and in India and South Africa, but in the Greek Hospital at Alexandria the death-rate was 32 among 300 cases (Sandwith).

In 1886 Weil described a disease characterized by the features just mentioned, but the cases occurred in groups, and a very large proportion in butchers. It is probable there are several types of acute infectious jaundice. The etiology is unknown. Some epidemics have been associated with paratyphoid bacillus infection. The *proteus* has been described in connection with Weil's disease. In the fatal case from North Carolina the autopsy threw no light on the nature of the disease. The *proteus* was isolated from the liver and kidney, and four other organisms from various parts. It is possible that acute catarrhal jaundice is a mild infection, representing the sporadic form of the disease.

XVIII. MILK-SICKNESS

This remarkable disease prevails in certain districts of the United States, west of the Alleghany Mountains, and is connected with the affection in cattle known as the *trembles*. It prevailed extensively in the early settlements in certain of the Western States and proved very fatal. The general opinion is that it is communicated to man only by eating the flesh or drinking the milk of diseased animals. The butter and cheese are also poisonous. In animals, cattle and the young of horses and sheep are most susceptible. It is stated that cows giving milk do not themselves show marked symptoms unless driven rapidly, and, according to Graff, the secretion may be infective when the disease is latent. When a cow is very ill, food is refused, the eyes are injected, the animal staggers, the entire muscular system trembles, and death occurs in convulsions, sometimes with great suddenness. The disease is most frequent in new settlements.

In man the symptoms are those of a more or less acute intoxication. After a few days of uneasiness and distress the patient is seized with pains in the stomach, nausea and vomiting, fever and intense thirst. There is usually obstinate constipation. The tongue is swollen and tremulous, the breath is extremely foul, and, according to Graff, is as characteristic of the disease as is the odor in small-pox. Cerebral symptoms—restlessness, irritability, coma, and convulsions—are sometimes marked, and there may gradually be produced a typhoid state in which the patient dies.

The duration of the disease is variable. In the most acute form death occurs within two or three days. It may last for ten days, or even for three or four weeks. Graff states that insanity occurred in one case. The poisonous nature of the flesh and of the milk has been demonstrated experimentally. An ounce of butter or cheese, or four ounces of the beef, raw or boiled, given three times a day, will kill a dog within six days. Fortunately, the disease has become rare. No definite pathological lesions are known. Jordan and Harris have studied a New Mexico epidemic (1908) and have found a bacillus (*B. lactimorbi*) with cultures of which the disease may be reproduced in other animals.

XIX. GLANDULAR FEVER

Definition.—An infectious disease of children, developing, as a rule, without premonitory signs, and characterized by slight redness of the throat, high fever, swelling and tenderness of the lymph-glands of the neck, particularly those behind the sterno-cleido-mastoid muscles. The fever is of short duration, but the enlargement of the glands persists for from ten days to three weeks.

In children acute adenitis of the cervical and other glands with fever has been noted by many observers, but Pfeiffer in 1889 called special attention to it under the name of *Druesenfieber*. He described it as an infectious disease of young children between the ages of five and eight years, characterized by the above-mentioned symptoms. Since Pfeiffer's paper a good deal of work has been done in connection with the subject, and in the United States West and Hamill, and in England Dawson Williams, have more particularly emphasized the condition.

Etiology.—It may occur in epidemic form. West, of Bellaire, Ohio, described an epidemic of 96 cases in children between the ages of seven months and thirteen years. Bilateral swelling of the carotid lymph-glands was a most marked feature. In three-fourths of the cases the post-cervical, inguinal, and axillary glands were involved. The mesenteric glands were felt in 37 cases, the spleen was enlarged in 57, and the liver in 87 cases. Coryza was not present, and there were no bronchial or pulmonary symptoms. Cases occurred between the months of October and June. The nature of the infection has not been determined.

Symptoms.—The onset is sudden and the first complaint is of pain on moving the head and neck. There may be nausea and vomiting and abdominal pain. The temperature ranges from 101° to 103°. The tonsils may be a little red and the lymphatic tissues swollen, but the throat symptoms are quite transient and unimportant. On the second or third day the enlarged glands appear, and during the course they vary in size from a pea to a goose-egg. They are painful to the touch, but there is rarely any redness or swelling of the skin, though at times there is some puffiness of the subcutaneous tissues of the neck, and there may be a little difficulty in swallowing. In some instances there has been discomfort in the chest and a paroxysmal cough, indicating involvement of the tracheal and bronchial glands. The swelling of the glands persists for from two to three weeks. Among the serious features ~~of the disease~~ are the termination of the adenitis in suppuration, which seems rare (though Neumann ~~has~~ met with it in 13 cases), and hæmorrhagic nephritis. Acute otitis media and retro-pharyngeal abscess have also been reported.

The outlook is favorable. West suggests the use of small doses of calomel during the height of the trouble.

XX. MILIARY FEVER—SWEATING SICKNESS

The disease is characterized by fever, profuse sweats, and an eruption of miliary vesicles. It prevailed and was very fatal in England in the fifteenth

and sixteenth centuries, and was made the subject of an important memoir by Johannes Caius, 1552. Of late years it has been confined entirely to certain districts in France (Picardy) and Italy. An epidemic of some extent occurred in France in 1887. Hirsch gives a chronological account of 194 epidemics between 1718 and 1879, many of which were limited to a single village or to a few localities. Occasionally the disease has become widely spread. Slight epidemics have occurred in Germany and Switzerland. Within the past few years there have been several small outbreaks in Austria. They are usually of short duration, lasting only for three or four weeks—sometimes not more than seven or eight days. As in influenza, a very large number of persons are attacked in rapid succession. In the mild cases there is only slight fever, with loss of appetite, and erythematous eruption, profuse perspiration, and an outbreak of miliary vesicles. The severe cases present the symptoms of intense infection—delirium, high fever, profound prostration, and hæmorrhage. The death-rate at the outset of the disease is usually high, and, as is so graphically described in the account of some of the epidemics of the middle ages, death may occur in a few hours.

XXI. FOOT-AND-MOUTH DISEASE—EPIDEMIC STOMATITIS—APHTHOUS FEVER

Foot-and-mouth disease is an acute infectious disorder met with chiefly in cattle, sheep, and pigs, but attacking other domestic animals. It is of extraordinary activity, and spreads with "lightning rapidity" over vast territories, causing very serious losses. In cattle, after a period of incubation of three or five days, the animal becomes feverish, the mucous membrane of the mouth swells, and little grayish vesicles the size of a hemp seed begin to develop on the edges and lower portion of the tongue, on the gums, and on the mucous membrane of the lips. They contain at first a clear fluid, which becomes turbid, and then they enlarge and gradually become converted into superficial ulcers. There is ptyalism, and the animals lose flesh rapidly. In the cow the disease is also frequently seen about the udder and teats, and the milk becomes yellowish-white in color and of a mucoid consistency.

The transmission to man is by no means uncommon, and several important epidemics have been studied in the neighborhood of Berlin. In Zuill's translation of Friedberger and Fröhner's Pathology and Therapeutics of Domestic Animals (Philadelphia, 1895) the disease is thus described: "In man the symptoms are: fever, digestive troubles, and vesicular eruption upon the lips, the buccal and pharyngeal mucous membranes (angina). The disease does not seem to be transmissible through the meat of diseased animals."

In widespread epidemics there has been sometimes a marked tendency to hæmorrhages. The disease runs, as a rule, a favorable course, but in Siegel's report of an epidemic the mortality was 8 per cent.

When epidemics are prevailing in cattle the milk should be boiled, and the proper prophylactic measures taken to isolate both the cattle and the individuals who come in contact with them.

XXII. PSITTACOSIS

A disease in birds, characterized by loss of appetite, weakness, diarrhœa, convulsions, and death. In Germany, France, and Italy a disease in man characterized by an atypical pneumonia, great weakness and depression, and signs of a profound infection has been ascribed to contagion from birds, particularly parrots. There have usually been house epidemics with a very high rate of mortality. A few cases have been reported in England, and Vickery, of Boston, has reported three probable cases. The bacteriology is still doubtful.

XXIII. ROCKY MOUNTAIN SPOTTED FEVER; TICK FEVER

In the Bitter-root Valley of Montana and in the mountains of Idaho, Nevada, and Wyoming there is an acute infection characterized by chill, fever, pains in back and bones, and a macular rash, becoming hæmorrhagic. It is estimated that seven or eight hundred cases occur annually, with 75 or 80 deaths. It was reported upon occasionally by army surgeons—e. g., Wood—but nothing definite was known until the careful studies of Wilson and Chowning (1902), who described a piroplasma in the blood, and believed the disease to be transmitted by ticks. This latter point has been confirmed, but the existence of the piroplasma is doubtful. The studies of King and Ricketts have demonstrated beyond doubt the transmission of the disease by the tick, *Dermacentor occidentalis,* but the true parasite has not been determined. The tick is widely distributed over the Rocky Mountain regions as far south as New Mexico. It lives on the larger domestic animals, cattle and horses, and is in this way brought into close proximity with human beings. The disease is readily given to the guinea-pig and monkey, and is transmissible from one animal to another by the bite of the tick. Immunity is given by an attack, and in animals this is transmitted to the young. After an incubation of from three to ten days the disease begins with a chill, fever, and severe pains in the limbs. The rash appears from the second to the seventh day, is macular, dark, and becomes hæmorrhagic. Illustrations of it show a rash not unlike that of typhus. The skin is often swollen. Hæmorrhages from the mucous membranes are not uncommon. The temperature range is from 103° to 105° F., and at the height of the disease there is delirium and stupor. Convalescence begins in the fourth week. The death-rate is high for an eruptive fever, reaching 70 per cent. in Montana, but in Idaho it is not more than 2 or 3 per cent. As a prophylactic measure, destruction of the ticks by dipping or scouring the horses and cattle should be carried out. The treatment is that of an acute infection.

XXIV. SWINE FEVER

A few cases have been described from accidental inoculation in the preparation of cultures and in making post mortems upon pigs. In the course of from twelve hours to three days there is swelling of the fingers of the affected hand, which have a blue-red color, and small nodules form. In some

Tibetan [illegible]

Japanese observers (Spirochaeta morsus-muris)
[illegible] Spirochetes found in local ampleri in skin of
enlarged lymph nodes from whence they appear in the blood

Name Spirochaete morsus-muris suggested

So? Spirochaete or dicyptothrix -
Spirochaetes can [illegible] detected better by [illegible] in mice.
found in blood after 5-10 days
salvarsan very effectual.

Moreover G. pigs have [illegible] after being [illegible]
symptoms much like human - [illegible]

of the instances the course has been like that of a painful erythema migrans, with swelling of the lymph-glands. A specific serum has been used with success in several cases.

XXV. RAT-BITE FEVER

A remarkable infection, following rat-bite, characterized by brief febrile paroxysms which may recur at intervals for months.

The disease has been known in China and Japan for several centuries. Attention has been called to it in this country by Horder and in the United States by Proescher. In a recent statistical account from the *Institution for Infectious Diseases* it appears that there have been 49 cases in Japan in the past thirteen years. The features are very unusual. There is a prolonged period of incubation, lasting in some cases for many months. The wound, which has run the ordinary course and perhaps healed, becomes swollen, red, and eroded; an ulcer forms and the regional lymph-glands are involved. The fever sets in suddenly with a chill and lasts three or four days. With its onset there is a skin rash, either erythema or a blotchy eruption somewhat resembling measles. The patient feels very ill, there may be pains in the muscles and joints and sometimes delirium. After persisting for a few days, the temperature falls and the patient feels quite well again. After a varying interval of from a few days to a couple of weeks the attack is repeated, and this may go on for several months or, according to the Japanese reports, for several years. The outlook is favorable; among the 49 Japanese cases only 1 died.

In Horder's last case the boy was bitten on September 15th. From October 6th to 11th, on the 13th, 14th, 17th, 18th, 19th, 23d, 24th, 25th, 28th to 30th, and November 4th, 5th, and 6th, he had attacks of fever, the temperature rising to between 104° and 105° F., and once reaching nearly 106°. Each attack was associated with a rash.

The nature of the disease is unknown. It is probably protozoal, and in one of Horder's cases spirilla were seen. Ogata describes a sporozoan parasite, and Proescher a bacillus.

Treatment.—The wound should be cauterized, and the febrile paroxysms treated symptomatically.

SECTION II

DISEASES DUE TO PHYSICAL AGENTS

I. SUNSTROKE; HEAT EXHAUSTION

(*Insolation, Thermic Fever, Siriasis*)

Definition.—Under these terms are comprised certain manifestations following exposure to excessive heat, of which thermic fever, or sunstroke, heat exhaustion, and heat cramps are the common forms.

History.—It is one of the oldest of recognized diseases. The case of the son of the Shunammite woman (2 Kings, IV) is perhaps the oldest on record. The Arabians called the symptoms due to excessive heart "Siriasis," after Sirius the Dog Star. Cardan recognized it in the sixteenth century and thought it was apoplexy due to heat—morbus attonitus. In the eighteenth century Boerhaave regarded it as phrenitis. It was not until the nineteenth century that the Anglo-Indian surgeons and the physicians of the United States gave us a full knowledge of the different affections due to excessive heat. Various classifications have been suggested, but two chief forms are everywhere recognized—heat exhaustion and thermic fever or sunstroke—to which ~~recently~~ Edsall has added the remarkable heat cramps which occur in persons working under very high external temperatures.

Distribution.—Sunstroke occurs in the tropics and in temperate regions during protracted heat waves. It is very common in the Atlantic Coast cities of the United States during the hot spells of summer. In New York and Philadelphia many hundreds of cases may occur daily. It has not been common in Panama. During 1910 no death from it was recorded among nearly 50,000 employees. Heat exhaustion is frequently met with in conditions similar to those in which sunstroke takes place, and it is also a not infrequent affection in the engine-rooms of the large modern steamships, less often in foundries.

Heat Exhaustion.—In the tropics and in temperate regions during protracted heat waves many persons become depressed physically and are unable to work or take nourishment. In children the condition is very often associated with gastro-intestinal disturbances and fever. The true heat syncope is specially seen in persons who have not been in good health or who are intemperate. The heat may be that of the sun or artificial heat, as in the engine-rooms of the large steamers. The symptoms begin with giddiness, nausea, an uncertain, staggering gait; there is pallor, the pulse is small, the heart's action weak, and the patient may quickly become unconscious. Ex-

ternally the body may be clammy, with sweat, but as a rule the rectal temperature is decreased. In the axilla it may be as low as 95° or 96° F. From slight attacks, such as are seen in the steamships, the patients recover rapidly when brought on deck; in other cases the unconsciousness may end in deep coma and death.

Thermic Fever.—This is more common in men than in women and children, and is principally seen in persons who work in very high external temperatures, and who are too heavily clad, or who are addicted to alcohol. In India regiments on the march are not infrequently attacked. It is more common in Europeans than in the dark races, but in the United States negroes are often attacked.

Morbid Anatomy and Pathology.—Rigor mortis occurs early. Putrefactive changes may come on with great rapidity. The venous engorgement is extreme, particularly in the cerebrum. The left ventricle is contracted (Wood) and the right chamber dilated. The blood is usually fluid; the lungs are intensely congested. Parenchymatous changes occur in the liver and kidneys.

Symptoms.—Many observers have called attention to a fever in the tropics which lasts for a few days, with no special symptoms other than those of pyrexia and weakness. As already mentioned, this may be simply heat exhaustion. It is not uncommon in the Southern States, particularly in Florida and the Carolinas, when it may be mistaken for malaria or mild typhoid fever. John Guitéras, who has unrivalled knowledge of tropical affections, regards these conditions as directly due to prolonged high external temperatures.

The patient may be struck down and die within an hour, with symptoms of heart-failure, dyspnœa, and coma. This form, sometimes known as the asphyxial, occurs chiefly in soldiers and is graphically described by Parkes. Death indeed may be almost instantaneous, the victims falling as if struck upon the head. The more usual form comes on during exposure, with pain in the head, dizziness, a feeling of oppression, and sometimes nausea and vomiting. Visual disturbances are common, and a patient may have colored vision. Diarrhœa or frequent micturition may supervene. Insensibility follows, which may be transient or which deepens into a profound coma. The patients are usually admitted to hospital in an unconscious state, with the face flushed, the skin hot, the pulse rapid and full, and the temperature ranging from 107° to 110° F., or even higher. F. A. Packard states that, of the 31 cases admitted to the Pennsylvania Hospital in the summer of 1887, in a majority of them the temperature was between 110° and 111° F. In one case the temperature was 112° F. The breathing is labored and deep, sometimes stertorous. Usually there is complete relaxation of the muscles, but twitchings, jactitation, or very rarely convulsions may occur. The pupils may at first be dilated, but by the time the patients are admitted to hospital they are (in a majority) extremely contracted. Petechiæ may be present upon the skin. In the fatal cases the coma deepens, the cardiac pulsations become more rapid and feeble, the breathing becomes hurried and shallow and of the Cheyne-Stokes type. The fatal termination may occur within twenty-four or thirty-six hours. Favorable indications are the return of consciousness and a fall in the fever. The recovery in these cases may be complete. In other

instances there are remarkable after-effects, the most constant of which is a permanent inability to bear high temperatures. Such patients become very uneasy when the thermometer reaches 80° F. in the shade. Loss of the power of mental concentration and failure of memory are more constant and very troublesome sequelæ. Such patients are always worse in the hot weather. Occasionally there are convulsions, followed by marked mental disturbance. Dercum has described peripheral neuritis as a sequence.

Diagnosis.—It is rarely difficult to distinguish thermic fever from the malignant types of malaria and from the various other forms of coma. The diagnosis in heat exhaustion or thermic fever is readily made. In the one

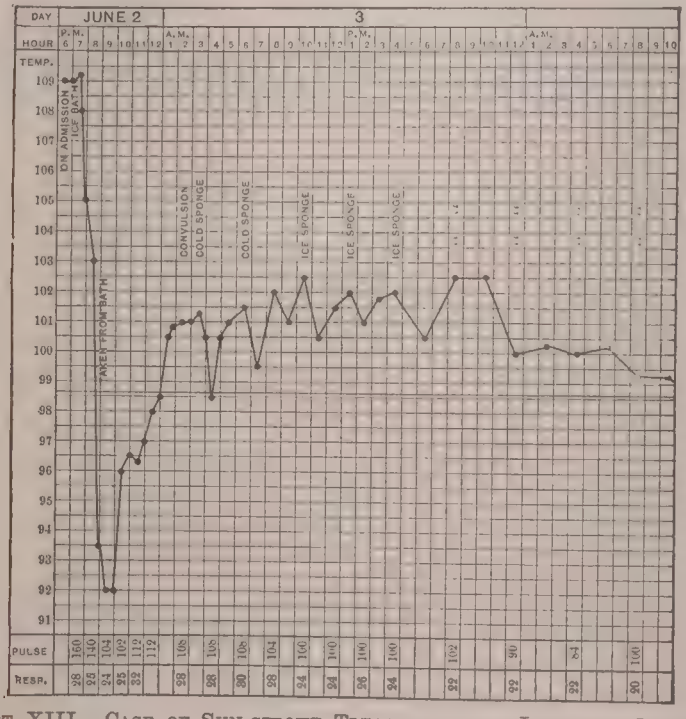

Chart XIII.—Case of Sun-stroke Treated by the Ice-bath; Recovery.

the skin is moist, pale, and cool, the pulse small and soft, and consciousness may remain till near the end; whereas in the other there is high fever with early unconsciousness.

Prognosis.—In the old, the infirm, and in alcoholic subjects the case mortality during a very hot wave may be as high as 30 or 40 per cent. In New York and Philadelphia the death-rate varies very much in different seasons.

Treatment.—In heat exhaustion stimulants should be given freely, and if the temperature is below normal the hot bath should be used. Ammonia may be given if necessary. In thermic fever the indications are to reduce the temperature as rapidly as possible. ~~This may be done by packing the patient in a bath with ice.~~ Rubbing the body with ice was practiced at the New York Hospital by Darrach in 1857, and is an excellent procedure to

N. which is dissolved in hydrofluoric acid to dissolve into an arsenic
pressure lowered
only harmful if the N. separates in the form of bubbles. These may
form in blood - synovial fluid of joints - the nervous system.
The bubbles to be formed the pressure gases have been lowered more
than 1/2 of absolute ambient in open water

lower the temperature rapidly. Ice-water enemata may also be employed. At the Pennsylvania Hospital in the summer of 1887 the ice-pack was used with great advantage. Of 31 cases only 12 died, results probably as satisfactory as can be obtained, considering that many of the patients are almost moribund when brought to hospital. They should be compared with Swift's statistics, in which, of 150 cases, 78 died. In the cases in which the symptoms are those of intense asphyxia, and in which death may take place in a few minutes, free bleeding should be practiced, a procedure which saved Weir Mitchell when a young man. For the convulsions, chloroform should be given at once. Of other remedies, the antipyretics have been employed, and may be given when there is any special objection to hydrotherapy, for which, however, they cannot be substituted.

Heat Cramps.—Persons who use the muscles while exposed to a very high temperature are liable to attacks of severe cramp. The condition, which has been described very thoroughly by Edsall, occurs principally in stokers in the furnace-rooms of steamships and in workers in iron foundries. The spasms occur spontaneously, chiefly in the muscles of the calves, the arms, and sometimes in the abdomen; they are often of great intensity and very painful. A movement, pressure, or any stimulus, as electricity, may send the muscle into spasm at once. In addition to ordinary cramps there are sometimes fibrillary contractions. The attacks may last for from 12 to 34 hours and are followed by muscular soreness and sometimes by great weakness.

II. CAISSON DISEASE

(*Compressed Air Disease; Diver's Paralysis*)

Definition.—A disease of caisson workers and divers, due to a saturation of the tissues with N under the increased pressure. If the decompression takes place quickly, a too-rapid escape of the N as bubbles into the blood causes air embolism.

History.—The French writers, Bucquoy, Foley, and Bert, first studied the disease. Leyden recognized the anatomical changes. A. H. Smith and others in the United States contributed important papers, and the recent studies of Haldane, Leonard Hill, and Boycott have thrown light upon the etiology and means of prevention.

Etiology.—The cases are met with chiefly in workers in caissons and tunnels and in divers. "The higher the pressure and the shorter the period of decompression the greater is the risk" (Hill). In caissons the pressure is rarely 30 to 35 pounds, but in the St. Louis bridge the pressure reached as high as 45 to 50 pounds. Divers go down to 20 fathoms with a pressure of 53 pounds; the record depth attained by divers is 210 feet (Hill). The disease may also occur in very deep mines.

In building the St. Louis bridge across the Mississippi, among 352 workers there were 50 cases of paralysis and 14 deaths. In making the Hudson River tunnel the cases were very numerous, and until the conditions were improved there were two or three deaths a month.

Pathology.—To Hoppe-Seyler, Bucquoy, and Paul Bert we owe a rational

explanation of the disease as due to gas absorption. During compression the blood passing through the lungs becomes saturated with nitrogen, which is carried to the tissues until the whole body is saturated. "The mass of blood is about 5 per cent. of the body, and the capacity of the tissues to dissolve N is estimated by Boycott as 35 times that of the blood—in a fat man considerably more" (Hill). With active work it does not take long to effect complete saturation. During decompression the process is just the reverse. "The blood gives up N to the alveolar air and returns to the tissues for more. Those organs in which the circulation is rapid will yield up their N quickly, and those with a sluggish circulation slowly . . . . . and at the end of decompression a condition may be set up in which the slow tissues still hold, say 3 per cent. of N, while the blood can dissolve only 1 per cent. Herein we have a danger of bubbles forming" (Hill). They are set free chiefly in the fatty tissues and in the venous blood. Experimentally all the symptoms can be produced in goats, and the spinal cord may contain numerous air emboli. This was the anatomical lesion determined by Leyden, who found fissuring and laceration of the cord, which explains the paraplegia. Pulmonary air embolism also occurs and is responsible for certain features of the disease.

Symptoms.—Within from half an hour to one hour after leaving the caisson, the patient may have headache, giddiness and feel faint, symptoms which may pass off and leave no further trouble. In other instances the patients have severe pains in the extremities, usually the legs and the abdomen, sometimes associated with nausea and vomiting—attacks which the workmen usually speak of as "the bends." The pains may be of the greatest intensity and associated with giddiness and vomiting. The paralysis, usually of the legs, comes on rapidly, and varies in degree from a slight paralysis to complete loss both of motion and sensation. This occurred in 15 per cent. of A. H. Smith's cases and in 61 per cent. of the St. Louis cases. Monoplegia and hemiplegia are rare. In extreme instances the attacks resemble apoplexy; the patient rapidly becomes comatose and death occurs in a few hours. The paraplegia may be permanent, but in slight cases it gradually disappears and recovery may be complete.

Prophylaxis.—The only safeguard is a gradual decompression, which obviates the risk of rapidly setting free the nitrogen from the tissues. Haldane and his colleagues have introduced what they call the "Stage Method," which is now widely adopted with the most beneficial results. For work in very high pressures the shifts should be short, not more than two hours.

Treatment.—The caisson workers found very early that the best remedy for "the bends" was immediate recompression, and Andrew H. Smith of New York introduced a medical air-lock for the Brooklyn bridge workers. The workers should live and sleep not far from the works, where such an air-lock should be provided for immediate treatment. Cases with severe symptoms may be saved by recompression. Hot fomentations, massage and hypodermics of morphia may be necessary for the extreme pains.

Aviators sickness - "mal des aviateurs"

problem involves low barometric pressure

Diffs. with diminished partial pressure of O_2 (O deficiency) accidents occur in the seven stages of this so called breathing r.v.b.c. increased

Haldane - pressure of O. in [illegible] to higher than in alveolar air rises in high altitudes [illegible] high altitudes an active ventilation of O. occurs into lungs i.e. pressure of O. in alveoli in increased diffusion. Applies only to O. the alveolar

Tendency to bradycardia in aviators after a sudden descent from the vagotonic syndrome

III. MOUNTAIN SICKNESS

Definition.—An illness associated with adaptation to low atmospheric pressures, characterized by cyanosis, nausea, headache, intestinal disturbances, hyperpnœa and sometimes fainting.

Pathology.—The symptoms are directly referable to want of oxygen produced by the diminished pressure of the atmosphere. Haldane, Douglas and Henderson ~~have recently~~ made an exhaustive study of the process of accommodation in a five weeks' residence at the top of Pike's Peak. After acclimatization the symptoms above mentioned disappeared, but dyspnœa, blueness and periodic breathing are apt to follow exertion. The alveolar carbon dioxide pressure was reduced from about 40 mm. to about 27 mm. during rest, which corresponded to an increase of about 50 per cent. in the ventilation of the lung alveoli. As has long been known, this process of accommodation is associated with a remarkable increase in the red blood corpuscles and hæmoglobin to 120 to 150 per cent. These authors conclude that the acclimatization is largely due to increased secretory activity of the alveolar epithelium, to the greater lung ventilation and to the increased hæmoglobin production.

Symptoms.—The symptoms just given, which are the most important, pass away gradually, but may return on exertion. In feeble persons the heart's action may be weak and intermittent, and syncope may follow any effort. Whymper in the ascent of Chimborazo at a height of 16,000 feet had headache, fever, gasping respiration and great weakness. Nausea, vomiting, bleeding at the nose, ringing in the ears and palpitation are not infrequent symptoms.

SECTION III

THE INTOXICATIONS

I. ALCOHOLISM

(a) Acute Alcoholism.—When a large quantity of alcohol is taken, the influence is chiefly on the nervous system, and is manifested in muscular incoordination, mental disturbance, and, finally, narcosis. The individual presents a flushed, sometimes slightly cyanosed face, the pulse is full, respirations deep but rarely stertorous. The pupils are dilated. The temperature is frequently below normal, particularly if the patient has been exposed to cold. Perhaps the lowest reported temperatures have been in cases of this sort. An instance is on record in which the patient on admission to hospital had a temperature of 24° C. (ca. 75° F.), and ten hours later the temperature had not risen to 91° F. The unconsciousness is rarely so deep that the patient cannot be roused to some extent, and in reply to questions he mutters incoherently. Muscular twitchings may occur, but rarely convulsions. The breath has a heavy alcoholic odor. The respirations may be slow; in one case they were only six in the minute.

The diagnosis is not difficult, yet mistakes are frequently made. Persons are brought to a hospital by the police supposed to be drunk when in reality they are dying from apoplexy. Too great care cannot be exercised, and the patient should receive the benefit of the doubt. In some instances the mistake has arisen from the fact that a person who has been drinking heavily has been stricken with apoplexy. In this condition the coma is usually deeper, stertor is present, and there may be evidence of hemiplegia in the greater flaccidity of the limbs on one side. The diagnosis will be considered in the section upon uræmic coma.

Dipsomania is a form of acute alcoholism seen in persons with a strong hereditary tendency to drink. Periodically the victims go "on a spree," but in the intervals they are entirely free from any craving for alcohol.

(b) Chronic Alcoholism.—In moderation, wine, beer, and spirits may be taken throughout a long life without impairing the general health.

The poisonous effects of alcohol are manifested (1) as a functional poison, as in acute narcosis; (2) as a tissue poison, in which its effects are seen on the parenchymatous elements, particularly epithelium and nerve, producing a slow degeneration, and on the blood vessels, causing thickening and ultimately fibroid changes; and (3) as a checker of tissue oxidation, since the alcohol is consumed in place of the fat. This leads to fatty changes and sometimes to a condition of general steatosis.

As a scheme of mitigation of the [illegible]

Brain tissue taken up immediately in
Bouin's solution. J.A.M.A.
1916. 67. 1822

The chief effects of chronic alcohol poisoning may be thus summarized:

Nervous System.—Functional disturbance is common. Unsteadiness of the muscles in performing any action is a constant feature. The tremor is best seen in the hands and in the tongue. The mental processes may be dull, particularly in the early morning hours, and the patient is unable to transact any business until he has had his accustomed stimulant. Irritability of temper, forgetfulness, and a change in the moral character of the individual gradually come on. The judgment is seriously impaired, the will enfeebled, and in the final stages dementia may supervene. An interesting combination of symptoms in chronic alcoholics is characterized by peripheral neuritis, loss of memory, and pseudo-reminiscences—that is, false notions as to the patient's position in time and space, and fabulous explanations of real occurrences. The peripheral neuritis is not always present; there may be only tremor and jactitation of the lips, and thickness of the speech, with visual hallucinations. The mental condition was described by Jackson and by Wilks. Korsakoff speaks of it as a *psychosis polyneuritica*, and the symptom-complex is sometimes called by his name. The relation of chronic alcoholism to insanity has been much discussed. ~~According to Savage, of 1,000 patients admitted to the Bethlehem Hospital, 133~~ gave drink as the cause of their insanity. Chronic alcoholism is ~~certainly~~ one of the important elements in the strain which leads to mental breakdown. Epilepsy may result directly from chronic drinking. It is a hopeful form, and may disappear entirely with a return to habits of temperance.

There is a remarkable condition in chronic alcoholism termed *"wet brain,"* in which a heavy drinker, who may perhaps have had attacks of delirium tremens, begins to get drowsy or a little more befuddled than usual; gradually the stupor deepens until he becomes comatose, in which state he may remain for weeks. There may be slight fever, but there are no signs of paralysis, and no optic neuritis. The urine may be normal. The lumbar puncture yields a clear fluid, but under high pressure. In one case, which died at the end of six weeks, there were the anatomical features of a serous meningitis.

No characteristic changes are found in the nervous system. Hæmorrhagic pachymeningitis is not very uncommon. There are opacity and thickening of the pia-arachnoid membranes, with more or less wasting of the convolutions. These are in no way peculiar to chronic alcoholism, but are found in old persons and in chronic wasting diseases. In the very protracted cases there may be chronic encephalo-meningitis with adhesions of the membranes. Finer changes in the nerve-cells, their processes, and the neuroglia have been described. By far the most striking effect of alcohol on the nervous system is the production of the alcoholic neuritis, which will be considered later.

Digestive System.—Catarrh of the stomach is the most common symptom. The toper has a furred tongue, heavy breath, and in the morning a sensation of sinking at the stomach until he has had his dram. The appetite is usually impaired and the bowels are constipated. In beer-drinkers dilatation of the stomach is common.

Alcohol produces definite changes in the liver, leading ultimately to the various forms of cirrhosis, ~~to be described.~~ In Welch's laboratory J. Friedenwald has caused typical cirrhosis in rabbits by the administration of alcohol. The effect is a primary degenerative change in the liver-cells. A special vul-

nerability of the liver-cells is necessary in the etiology of alcoholic cirrhosis. There are cases in which comparatively moderate drinking for a few years has been followed by cirrhosis; on the other hand, the livers of persons who have been steady drinkers for thirty or forty years may show only a moderate grade of sclerosis. For years before cirrhosis develops heavy drinkers may present an enlarged and tender liver, with at times swelling of the spleen. With the gastric and hepatic disorders the facies often becomes very characteristic. The venules of the cheeks and nose are dilated; the latter becomes enlarged, red, and may present the condition known as *acne rosacea*. The eyes are watery, and conjunctivæ hyperæmic and sometimes bile-tinged.

The *heart and arteries* in chronic topers show degenerative changes, and alcoholism is a factor in causing arterio-sclerosis. Steell has pointed out the frequency of cardiac dilatation in these cases.

Kidneys.—The influence of chronic alcoholism upon these organs is by no means so marked. According to Dickinson the total of renal disease is not greater in the drinking class, and he holds that the effect of alcohol on the kidneys has been much overrated. Formad has directed attention to the fact that in a large proportion of chronic alcoholics the kidneys are increased in size. The Guy's Hospital statistics support this statement, and Pitt notes that in 43 per cent. of the bodies of hard drinkers the kidneys were hypertrophied without showing morbid change. A granular kidney may result indirectly through the arterial changes.

It was formerly thought that alcohol was in some way antagonistic to tuberculous disease, but the observations of late years indicate clearly that the reverse is the case and that chronic drinkers are much more liable to both acute and pulmonary tuberculosis. It is probably altogether a question of altered tissue-soil, the alcohol lowering the vitality and enabling the bacilli more readily to develop and grow.

(c) **Delirium tremens** (*mania a potu*), an incident in the history of chronic alcoholism, results from the long-continued action of the poison on the brain. The condition was first accurately described early in the 19th century by Sutton, of Greenwich, who had numerous opportunities for studying the different forms among sailors. One of the most careful studies of the disease was made by Ware, of Boston. A spree in a temperate person, no matter how prolonged, is rarely if ever followed by delirium tremens; but in the case of an habitual drinker a temporary excess is apt to bring on an attack. It sometimes follows in consequence of the sudden withdrawal of the alcohol. An accident, a sudden fright or shock, or an acute inflammation, particularly pneumonia, may determine the onset. It is especially apt to occur in drinkers admitted to hospitals for injuries, especially fractures, and, as this seems most likely to occur when the alcohol is withdrawn, it is well to give such patients a moderate amount of alcohol. At the outset of the attack the patient is restless and depressed and sleeps badly, symptoms which cause him to take alcohol more freely. After a day or two the characteristic delirium sets in. The patient talks constantly and incoherently; he is incessantly in motion, and desires to go out and attend to some imaginary business. Hallucinations of sight and hearing develop. He sees objects in the room, such as rats, mice, or snakes, and fancies that they are crawling over his body. The terror inspired by these imaginary objects is great, and has given the popular name

"horrors" to the disease. The patients need to be watched constantly, for in their delusions they may jump out of the window or escape. Auditory hallucinations are not so common, but the patient may complain of hearing the roar of animals or the threats of imaginary enemies. There is much muscular tremor; the tongue is covered with a thick white fur, and when protruded is tremulous. The pulse is soft, rapid, and readily compressed. There is usually fever, but the temperature rarely registers above 102° or 103°. In fatal cases it may be higher. Insomnia is a constant feature. On the third or fourth day in favorable cases the restlessness abates, the patient sleeps, and improvement gradually sets in. The tremor persists for some days, the hallucinations gradually disappear, and the appetite returns. In more serious cases the insomnia persists, the delirium is incessant, the pulse becomes more frequent and feeble, the tongue dry, the prostration extreme, and death takes place from gradual heart-failure.

There is a condition termed *acute hallucinosis,* in which auditory hallucinations are marked, orientation is retained, and the mental disturbances are fixed. Ideas of persecution are common. There are intermediate forms between this and the ordinary delirium tremens.

Diagnosis.—The clinical picture of the disease can scarcely be confounded with any other. Cases with fever, however, may be mistaken for meningitis. By far the most common error is to overlook some local disease, such as pneumonia or erysipelas, or an accident, as a fractured rib, which in a chronic drinker may precipitate an attack of delirium tremens. In every instance a careful examination should be made, particularly of the lungs. It is to be remembered that in the severer forms, particularly the febrile cases, congestion of the bases of the lungs is by no means uncommon. Another point to be borne in mind is the fact that pneumonia of the apex is apt to be accompanied by delirium similar to *mania a potu.*

Prognosis.—Recovery takes place in a large proportion of the cases in private practice. In hospital practice, particularly in ~~the~~ large city hospitals to which ~~the~~ debilitated patients are taken, the death-rate is higher. Gerhard states that of 1,241 cases admitted to the Philadelphia Hospital 121 proved fatal. Recurrence is frequent, almost, ~~indeed,~~ the rule, if the drinking is kept up.

Treatment.—Acute alcoholism rarely requires any special measures, as the patient sleeps off the effects of the debauch. In the case of profound alcoholic coma it may be advisable to wash out the stomach, and if collapse symptoms occur the limbs should be rubbed and hot applications made to the body. Should convulsions supervene, chloroform may be carefully administered. In the acute, violent alcoholic mania the hypodermic injection of apomorphia, one-eighth or one-sixth of a grain, is usually very effectual, causing nausea and vomiting, and rapid disappearance of the maniacal symptoms.

Chronic alcoholism is a condition very difficult to treat, and once fully established the habit is rarely abandoned. The most obstinate cases are those with marked hereditary tendency. Withdrawal of the alcohol is the first essential. This is most effectually accomplished by placing the patient in an institution, in which he can be carefully watched during the trying period of the first week or ten days of abstention. The absence of temptation in institution life is of special advantage. For the sleeplessness the bromides

or hyoscine may be employed. Quinine and strychnine in tonic doses may be given. Cocaine or the fluid extract of coca has been recommended as a substitute for alcohol, but it is not of much service. Prolonged seclusion in a suitable institution is in reality the only effectual means of cure. When an hereditary tendency exists a lapse into the drinking habit is almost inevitable.

In delirium tremens the patient should be confined to bed and carefully watched night and day. The danger of escape in these cases is very great, as the patient imagines himself pursued by enemies or demons. Flint mentions the case of a man who escaped in his nightclothes and ran barefooted for fifteen miles on the frozen ground before he was overtaken. The patient should not be strapped in bed, as this aggravates the delirium; sometimes, however, it may be necessary, in which case a sheet tied across the bed may be sufficient, and this is certainly better than violent restraint by three or four men. Alcohol should be withdrawn at once unless the pulse is feeble.

Delirium tremens is a disease which, in a large majority of cases, runs a course very slightly influenced by medicine. The indications for treatment are to procure sleep and to support the strength. In mild cases half a drachm (2 gm.) of bromide of potassium combined with tincture of capsicum may be given every three hours. Chloral is often of great service, and may be given without hesitation unless the heart's action is feeble. Good results sometimes follow the hypodermic use of hyoscine, one one-hundredth of a grain. Opium must be used cautiously. A special merit of Ware's work was the demonstration that on a rational or expectant plan of treatment the percentage of recoveries was greater than with the indiscriminate use of sedatives, which had been in vogue for many years. When opium is indicated it should be given as morphia, hypodermically. The effect should be carefully watched, and, if after three or four quarter-grain doses have been given the patient is still restless and excited, it is best not to push it farther. Repeated doses of trional (grs. xv-xx) every four hours may be tried. Lambert advises ergotin hypodermically in both the acute and chronic alcoholism. When fever is present the tranquilizing effects of a cold douche or cold bath may be tried, or the cold or warm packs. The large doses of digitalis formerly employed are not advisable.

Careful feeding is the most important element in the treatment of these cases. Milk and concentrated broths should be given at stated intervals. If the pulse becomes rapid and shows signs of flagging, alcohol may be given in combination with the aromatic spirits of ammonia.

II. MORPHIA HABIT

~~(*Morphinomania, Morphinism*)~~

Taken at first to allay pain, a craving for the drug is gradually engendered and the habit in this way acquired. The effects of the constant use of opium vary very much. In the East, where opium-smoking is as common as tobacco-smoking with us, the ill effects are, according to good observers, not very striking. Taken as morphia and hypodermically, as is the rule, it is very injurious, but a moderate amount may be taken for years without serious damage.

Hogan. J.A.M.A. 1916. 67. 1826

Camp acidosis- urea calcic soda + glucose. nitrous only.

Sod. chlorid 5.8 gm
" bicarb. 8.4 gm. | boiled in 120 cc. distilled - filtered + cooled

" bromide. 10.2 gm. in 30 c.c.

added to 850 cc. fresh boiled water distilled.

glucose added. 80 gm in 250 cc. " —

—

20 - 30 min. taken in pitcher of 1250 cc.

The habit is particularly prevalent among women and physicians who use the hypodermic syringe for the alleviation of pain, as in neuralgia or sciatica. The acquisition of the habit as a pure luxury is rare.

Symptoms.—The symptoms at first are slight and for months there may be no disturbance of health. There are exceptional instances in which for a period of years excessive amounts have been taken without deterioration of the mental or bodily functions. As a rule, the dose necessary to obtain the desired sensation has gradually to be increased. As the effects wear off the victim experiences sensations of lassitude and mental depression, accompanied often with slight nausea and epigastric distress, or even recurring colic, which may be mistaken for appendicitis. The confirmed opium-eater usually has a sallow, pasty complexion, is emaciated, and becomes prematurely gray. He is restless, irritable, and unable to remain quiet for any time. Itching is a common symptom. The sleep is disturbed, the appetite and digestion are deranged, and except when directly under the influence of the drug the mental condition is one of depression. Occasionally there are profuse sweats, which may be preceded by chills. The pupils, except when under the direct influence of the drug, are dilated, sometimes unequal. In one case there was a persistent œdema of the legs without sufficient renal changes or anæmia to account for it. Persons addicted to morphia are inveterate liars, and no reliance whatever can be placed upon their statements. In many instances this is not confined to matters relating to the vice. In women the symptoms may be associated with those of pronounced hysteria or neurasthenia. The practice may be continued for an indefinite time, usually requiring increase in the dose until ultimately enormous quantities may be needed to obtain the desired effect. Finally a condition of asthenia is induced, in which the victim takes little or no food and dies from the extreme bodily debility. An increase in the dose is not always necessary, and there are *habitués* who reach the point of satisfaction with a daily amount of 2 or 3 grains of morphia, and who are able to carry on successfully for many years the ordinary business of life. They may remain in good physical condition, and indeed often look ruddy.

Treatment.—The treatment of the morphia habit is extremely difficult, and can rarely be successfully carried out by the general practitioner. Isolation, systematic feeding, and gradual withdrawal of the drug are the essential elements. As a rule, the patients must be under control in an institution and should be in bed for the first ten days. It is best in a majority of cases to reduce the morphia gradually. The diet should consist of beef-juice, milk, and egg-white, which should be given at short intervals. The sufferings of the patients are usually very great, more particularly the abdominal pains, sometimes nausea and vomiting, and the distressing restlessness. Usually within a week or ten days the opium may be entirely withdrawn. In all cases the pulse should be carefully watched and, if feeble, stimulants should be given, with the aromatic spirit of ammonia and digitalis. For the extreme restlessness a hot bath is serviceable. The sleeplessness is the most distressing symptom, and various drugs may have to be resorted to, particularly hyoscine and sulphonal and sometimes, if the insomnia persists, morphia itself.

It is essential in the treatment of a case to be certain that the patient has no means of obtaining morphia. Even under the favorable circumstances of seclusion in an institution, and constant watching by a night and a day nurse,

I have known a patient to practice deception for a period of three months. After an apparent cure the patients are only too apt to lapse into the habit.

The condition is one which has become so common, and is so much on the increase, that physicians should exercise the utmost caution in prescribing morphia, particularly to female patients. Under no circumstances should a patient be allowed to use the hypodermic syringe, and it is even safer not to intrust this dangerous instrument to the hands of the nurse.

III. LEAD POISONING

(Plumbism, Saturnism)

Etiology.—The disease is widespread, particularly in the lead industries and among plumbers, painters, and glaziers. For the ten years ending 1909, 8,973 cases with 667 deaths were reported to the Home Office (England) as occurring in 18 industries, but Legge points out there has been in this period a reduction of more than 50 per cent. of cases. In the United States it is not easy to get accurate statistics. Alice Hamilton reports 358 cases with 16 deaths in 23 white lead factories during the 16 months to May 1, 1911. In New York State in 1909 and 1910, 60 deaths were certified from lead poisoning. The metal is introduced into the system in many forms. Miners usually escape, but those engaged in the smelting of lead-ores are often attacked. Animals in the neighborhood of smelting furnaces have suffered with the disease, and even the birds that feed on the berries in the neighborhood may be affected. Men engaged in the white-lead factories are particularly prone to plumbism. Accidental poisoning may come in many ways; most commonly by drinking water which has passed through lead pipes or been stored in lead-lined cisterns. Wines and cider which contain acids quickly become contaminated in contact with lead. It was the frequency of colic in certain of the cider districts of Devonshire which gave the name of Devonshire colic, as the frequency of it in Poitou gave the name *colica Pictonum*. Among the innumerable sources of accidental poisoning may be mentioned milk, various sorts of beverages, hair dyes, false teeth, and thread. A few cases have followed the retention of lead bullets in gun-shot wounds. Given medicinally, lead rarely causes poisoning, but we had in the Johns Hopkins Hospital four cases following the use of lead and opium pills for dysentery, of which cause Miller has collected many cases from the literature. It has also followed the use of Emplastrum Diachylon to produce abortion, and there is a case reported in an infant from the application of lead-water on the mother's nipples. One grain every three hours for three days, and two grains every three hours for one day, have caused signs of poisoning. A serious outbreak of lead-poisoning, investigated by David D. Stewart, occurred in Philadelphia, owing to adulteration of a baking-powder with chromate of lead, which was used to give a yellow tint to the cakes.

All ages are attacked, but children are relatively less liable. The largest number of cases occur between thirty and forty. According to Oliver, females are more susceptible than males. They are much more quickly brought under its influence, and in a recent epidemic in which a thousand cases were in-

1515. 71 Deaths by Plague

volved the proportion of females to males was four to one. Miscarriage is common, and it is rare for a woman working in lead to carry a child to term. It also destroys the reproductive power in man.

The lead gains entrance to the system through the lungs, the digestive organs, or the skin. Poisoning may follow the use of cosmetics containing lead. Through the lungs it is freely absorbed. The chief channel, according to Oliver, is the digestive system. It is rapidly eliminated by the kidneys and skin, and is present in the urine of lead-workers. The susceptibility is remarkably varied. The symptoms may be manifest within a month of exposure. On the other hand, Tanquerel (des Planches) met with a case in a man who had been a lead-worker for fifty-two years.

Morbid Anatomy.—Small quantities of lead occur in the body in health. J. J. Putnam's reports show that of 150 persons not presenting symptoms of lead-poisoning traces of lead occurred in the urine of 25 per cent. Of 264 deaths in persons subjects of plumbism 32 were due to an encephalopathy, 43 to ~~Bright's disease~~, 47 to cerebral hæmorrhage, 43 to paralysis, 44 to lead poisoning, 38 to ~~phthisis~~, and 40 to various maladies, pneumonia, heart disease, aneurism, etc. (Legge).

In chronic poisoning lead is found in the various organs. The affected muscles are yellow, fatty, and fibroid. The nerves present the features of a peripheral degenerative neuritis. The cord and the nerve-roots are, as a rule, uninvolved. In the primary atrophic form the ganglion cells of the anterior horns are probably implicated. In the acute fatal cases there may be the most intense entero-colitis.

Symptoms.—Acute Form.—We do not refer here to the accidental or suicidal cases, which present vomiting, pain in the abdomen, and collapse symptoms. In workers in lead there are several manifestations which follow a short time after exposure and set in acutely. There may be, in the first place, a rapidly developing anæmia. Acute neuritis has been described, and convulsions, epilepsy, and a delirium, which may be not unlike that produced by alcohol. There are also cases in which the gastro-intestinal symptoms are ~~most~~ intense and rapidly prove fatal. These acute forms occur more frequently in persons recently exposed, and are more frequent in winter than in summer. Da Costa ~~has~~ reported the onset of hemiplegia after three days' exposure to ~~the poison~~ lead.

Chronic Poisoning.—(*a*) *Blood Changes.*—A moderate grade of *anæmia*, the so-called saturnine cachexia, is usually present. The corpuscles do not often fall below 50 per cent. Many of the red cells show a remarkable granular, *basophilic degeneration* when stained with Jenner's stain, or with polychrome methylene blue. Grawitz first demonstrated their presence in cases of pernicious anæmia, and Pepper (tertius) and White showed that they were constantly present in lead-poisoning. Further observations by Vaughan and others have shown that such granulations are found in the blood in a great variety of conditions, even in normal blood, but that they are most numerous in lead-poisoning, in which their occurrence in very large numbers is of considerable value in diagnosis. Cadwalader has shown the constant presence of *nucleated red blood-corpuscles* even when the anæmia is of very slight grade.

(*b*) *Blue line* on the gums, which is a valuable indication, but not invariably present. Two lines must be distinguished: one, at the margin be-

tween the gums and teeth, is on, not in the gums, and is readily removed by rinsing the mouth and cleansing the teeth. The other is the well-known characteristic blue-black line at the margin of the gum. The color is not uniform, but being in the papillæ of the gums the line is, as seen with a magnifying-glass, interrupted. The lead is absorbed and converted in the tissues into a black sulphide by the action of sulphuretted hydrogen from the tartar of the teeth. The line may form in a few days after exposure (Oliver) and disappear within a few weeks, or may persist for many months. Philipson has noted the occurrence of a black line in miners, due to the deposition of carbon.

The most important symptoms of chronic lead-poisoning are colic, lead-palsy, and the encephalopathy. Of these, the colic is the most frequent. Of Tanquerel's cases, there were 1,217 of colic, 101 of paralysis, and 72 of encephalopathy.

(*c*) *Colic* is the most common symptom of chronic lead-poisoning. It is often preceded by gastric or intestinal symptoms, particularly constipation. The pain is over the whole abdomen. The colic is usually paroxysmal, like true colic, and is relieved by pressure. There is often, in addition, between the paroxysms a dull, heavy pain. There may be vomiting. During the attack, as Riegel noted, the pulse is increased in tension and the heart's action is retarded. Attacks of pain with acute diarrhœa may recur for weeks or even for three or four years.

Certain of the cases with colic may present the features of an acute intra-abdominal inflammatory condition. A case may be admitted to the surgical wards with a diagnosis of appendicitis, or simulate intestinal obstruction. Localized pain, slight fever, and moderate leucocytosis may be present. The history, the presence of a blue line on the gums, and the blood changes are of importance in differential diagnosis.

(*d*) *Lead-palsy.*—This is rarely a primary manifestation. Among 54 cases of lead-poisoning treated in the J. H. H. and dispensary there were 30 cases of lead-paralysis (H. M. Thomas). The upper limbs are most frequently affected. In 26 cases the arms alone were affected, and 18 of these showed the typical double wrist-drop. In 7 the right arm alone was involved, and in one the left. In 4 cases both arms and legs were attacked. The onset may be acute, subacute, or chronic. It usually occurs without fever. In its distribution it may be partial, limited to a muscle or to certain muscle groups, or generalized, involving in a short time the muscles of the extremities and the trunk. Madame Déjerine-Klumpke recognizes the following *localized forms:* (1) Antebrachial type, paralysis of the extensors of the fingers and of the wrist. In this the musculo-spiral nerve is involved, causing the characteristic wrist-drop. The supinator longus usually escapes. In the long-continued flexion of the carpus there may be slight displacement backward of the bones, with distention of the synovial sheaths, so that there is a prominent swelling over the wrist known as Gruebler's tumor. (2) Brachial type, which involves the deltoid, the biceps, the brachialis anticus, and the supinator longus, rarely the pectorals. The atrophy is of the scapulo-humeral form. It is bilateral, and sometimes follows the first form, but it may be primary. (3) The Aran-Duchenne type, in which the small muscles of the hand and of the thenar and hypothenar eminences are involved. The atrophy is marked, and may be the first manifestation of the lead-palsy. Möbius has shown that this

form is particularly marked in tailors. (4) The peroneal type. According to Tanquerel, the lower limbs are involved in the proportion of 13 to 100 of the upper limbs. The lateral peroneal muscles, the extensor communis of the toes, and the extensor proprius of the big toe are involved, producing the *steppage* gait. (5) Laryngeal form. Adductor paralysis has been noted by Morell Mackenzie and others in lead-palsy.

Generalized Palsies.—There may be a slow, chronic paralysis, gradually involving the extremities, beginning with the classical picture of wrist-drop. More frequently there is a rapid generalization, producing complete paralysis in all the muscles of the parts in a few days. It may pursue a course like an ascending paralysis, associated with rapid wasting of all four limbs. Such cases, however, are very rare. Death has occurred by involvement of the diaphragm. Oliver reports a case of Philipson's in which complete paralysis supervened. A patient with generalized paralysis was admitted in the winter of 1904 in whom the paralysis began in the legs after but two weeks' work as an enameler. It spread rapidly, so that in a little over a week he was bedridden, and on admission to the hospital nearly every muscle below the neck was involved. The diaphragm was completely paralyzed. He was walking about when he left the hospital, though there was still some weakness remaining. Déjerine-Klumpke also recognizes a febrile form of general paralysis ~~in lead-poisoning~~, which may closely resemble the subacute spinal paralysis of Duchenne.

There is also a primary saturnine muscular atrophy in which the weakness and wasting come on together. It is this form, according to Gowers, which most frequently assumes the Aran-Duchenne type.

The electrical reactions are those of lesions of the lower motor segment. The reaction of degeneration in its different grades may be present, depending upon the severity of the disease. Usually with the onset of the paralysis there are pains in the legs and joints, the so-called saturnine arthralgias. Sensation may, however, be unaffected.

(*e*) The *cerebral symptoms* are numerous. Seven of our cases showed marked cerebral involvement. One had delusions and maniacal excitement and had to be removed to an asylum. In other cases there occurred transient delirium, attacks of unconsciousness, and in one case convulsions. Optic neuritis or neuro-retinitis may occur. Hysterical symptoms occasionally occur in girls. Convulsions are not uncommon, and in an adult the possibility of lead-poisoning should always be considered. True epilepsy may follow the convulsions. An acute delirium may occur with hallucinations. The patients may have trance-like attacks, which follow or alternate with convulsions. A few cases of lead encephalopathy finally drift into lunatic asylums. Tremor is one of the commonest manifestations of lead-poisoning.

(*f*) *Arterio-sclerosis.*—Lead-workers are notoriously subject to arterio-sclerosis with contracted kidneys and hypertrophy of the heart. The cases usually show distinct gouty deposits, particularly in the big-toe joint; but in the United States acute gout in lead-workers is rare. According to Sir William Roberts, the lead favors the precipitation of the crystalline urates ~~of the tissues~~.

Prognosis.—In the minor manifestations this is good. According to Gowers, the outlook is bad in the primary atrophic form of paralysis. Convulsions

are, as a rule, serious, and the mental symptoms which succeed may be permanent. Occasionally the wrist-drop persists.

Treatment.—Prophylactic measures should be taken at all lead-works, but, unless employees are careful, poisoning is apt to occur even under the most favorable conditions. Cleanliness of the hands and of the finger-nails, frequent bathing, and the use of respirators when necessary should be insisted upon. When the lead is in the system the iodide of potassium should be given in from 5- to 10-grain (0.3-0.6 gm.) doses three times a day. For the colic local applications and, if severe, morphia may be used. An occasional morning purge of magnesium sulphate may be given. For the anæmia iron should be used. In the very acute cases it is well not to give the iodide, as, according to some writers, the liberation of the lead which has been deposited in the tissues may increase the severity of the symptoms. For the local palsies massage and the constant current should be used. Bulletin No. 95 (1911) of the Bureau of Labor, Washington, contains an elaborate study of industrial lead-poisoning in Europe by Oliver, and of the conditions in the United States by Alice Hamilton and John B. Andrews.

IV. ARSENICAL POISONING

Acute poisoning by arsenic is common, particularly by Paris green and such mixtures as "Rough on Rats," which are used to destroy vermin and insects. The chief symptoms are intense pain in the stomach, vomiting, and, later, colic, with diarrhœa and tenesmus; occasionally the symptoms are those of collapse. If recovery takes place, paralysis may follow. The treatment should be similar to that of other irritant poisons—rapid removal with the stomach pump, the promotion of vomiting, and the use of milk and eggs. If the poison has been taken in solution, dialyzed iron may be used in doses of from 6 to 8 drachms.

Chronic Arsenical Poisoning.—Arsenic is used extensively in the arts, particularly in the manufacture of colored papers, artificial flowers, and in many of the fabrics employed as clothing. The glazed green and red papers used in kindergartens also contain arsenic. It is present, too, in many wall-papers and carpets. Much attention has been paid to this question ~~of late years~~, as instances of poisoning have been thought to depend upon wall-papers and other household fabrics. The arsenic compounds may be either in the form of solid particles detached from the paper or as gaseous volatile bodies formed from arsenical organic matter by the action of several moulds, notably *Penicilium brevicaule, Mucor mucedo,* etc. (Gosio). In moisture, and at a temperature of from 60° to 95° F., a volatile compound is set free, probably "an organic derivative of arsenic pentoxide" (Sanger). The chronic poisoning from fabrics and wall-papers may be due, according to this author, to the ingestion of minute continued doses of this derivative. Contaminated glucose, used in manufacturing beer, caused a widespread epidemic of poisoning at Manchester. The associated presence of selenium compounds may have played a part in the production of the poisoning (Tunnicliffe and Rosenheim). Arsenic is eliminated in all the secretions, and has been found in the milk. J. J. Putnam, it should be remembered, has shown that it is not uncommon

to find traces of arsenic in the urine of many persons in apparent health. The effects of moderate quantities of arsenic are not infrequently seen in medical practice. In chorea and in pernicious anæmia steadily increasing doses are often given until the patient takes from 15 to 20 drops of Fowler's solution three times a day. Flushing and hyperæmia of the skin, puffiness of the eyelids or above the eyebrows, nausea, vomiting, and diarrhœa are the most common symptoms. Redness and sometimes bleeding of the gums and salivation occur. In the protracted administration of arsenic patients may complain of numbness and tingling in the fingers. Cutaneous pigmentation and keratosis are very characteristic, and, as a late rare sequence of the latter, epithelioma. In chorea neuritis has occurred, and a patient of mine with Hodgkin's disease had multiple neuritis after taking ℥ iv ʒ j of Fowler's solution in seventy-five days, during which time there were fourteen days on which the drug was omitted.

In the Manchester epidemic nearly all cases presented signs of neuritis and lesions of the skin. In some the sensory disturbances predominated, in others the motor, the individuals being unable to walk or to use their hands. In a certain number there was muscular incoördination, resembling that of locomotor ataxia. Rapid muscular atrophy characterized some cases. In not a few ~~patients~~ a condition of erythromelalgia was present. Occasionally a catarrh of the respiratory and alimentary tracts was the chief feature. Pigmentation, keratosis, and herpes were the most characteristic cutaneous manifestations.

How far similar symptoms are to be attributed to the small quantities of arsenic absorbed from wall-papers and fabrics is by some considered doubtful. That children and adults may take with impunity large doses for months without unpleasant effects, and the fact of the gradual establishment of a toleration which enables Styrian peasants to take as much as 8 grains of arsenious acid in a day, speak strongly against it. On the other hand, as Sanger states, we do not know accurately the effects of many of the compounds in minute and long-continued doses, notably the arsenates.

Arsenical paralysis has the same characteristics as lead-palsy, but the legs are more affected than the arms, particularly the extensors and peroneal group, so that the patient has the characteristic *steppage* gait of peripheral neuritis.

The electrical reaction in the muscles may be disturbed before there is any loss of power, and when the patient is asked to extend the wrist fully and to spread the fingers slight weakness may be detected early.

V. FOOD POISONING

There may be "death in the pot" from many causes. Food poisons may be *endogenous* or *exogenous*. Those articles in which the poison is of endogenous origin can scarcely be designated as foods. The poisonous mushroom, for example, is often mistaken for the edible form. The former is injurious because it normally produces a highly poisonous alkaloid, muscarine. Certain fish also produce normal physiological but toxic products. When eaten by mistake, as frequently occurs in the West Indies and Japan, these fish may

cause poisonous symptoms. The exogenous origin of food poisons is by far the commonest. Under this head come those foods which are rendered poisonous by accidental contamination from outside sources. Food may contain the specific organisms of disease, as of tuberculosis or trichinosis; milk and other foods may become infected with typhoid bacilli, and so convey the disease.

Animals (or insects, as bees) may feed on substances which cause their flesh or products to be poisonous to man.

The grains used as food may be infected with fungi and cause the epidemics of ergotism, etc.

Foods of all sorts may become contaminated with the bacteria of putrefaction, the products of which may be highly poisonous.

The term "ptomaine poisoning" has been popularized to such an extent that it is used synonymously with food poisoning. The term *ptomaine* was introduced by the Italian chemist, Selmi, to designate basic alkaloidal products formed in putrefaction. It is largely through the labors of Brieger that our knowledge of ptomaines was gained. Mytilotoxin, found in poisonous mussels, is of this class, and is by far the most poisonous of the known ptomaines.

Among the more common forms are the following:

Meat Poisoning.—Outbreaks of disease due to poisons of bacterial origin or due to chemical changes in meat are not uncommon. Several groups of cases have been recognized.

(*a*) From the colon bacillus or the typho-coli group of organisms, which occupy a position intermediate between the typhoid and colon bacillus. In severe forms symptoms come on a few hours after eating the meat; violent vomiting, purging, pains in the abdomen and collapse and death may occur within twenty-four hours. Individuals react very differently, as shown in the remarkable outbreak investigated by McWeeney in the Industrial School, Limerick. Among 73 cases every grade of severity was seen, from severe cholera nostras to headache with slight fever. Indeed, there were cases without symptoms, but with the typhoid blood reaction.

Some of these cases have a close resemblance to the paratyphoid infection, and, as Durham pointed out, the bacilli are divisible into two groups: The Gaertner type (*B. enteritidis*) and the Aertryk type.

The important matter in connection with this type of poisoning is the unaltered appearance of the meat. The danger seems greatest from beef and veal, and in Germany has particularly followed the use of meat from cattle ill with some septic or diarrhœal condition. Pork is a not infrequent cause in England, and severe attacks have followed the eating of pork pies.

(*b*) Meat poisoning associated with putrefaction. Here alterations of appearance, of smell and taste are usually present. The products are those of protein hydrolysis, various aromatic compounds, but more particularly the bodies known as putrescine, cadaverine and sepsin. How far these bodies themselves are responsible for the symptoms, how far they are due to infection with associated organisms, particularly the proteus and the colon bacilli, has not yet been definitely settled. Many cases of food poisoning have been reported as due to proteus and its toxins. A point of interest is the fact that this organism was found to be the cause of a severe outbreak due to eating potato salad.

Dickens. B. tuberculosis. cervical protrusion not nec. to develop
of tuberculosis. may be
produced in medium made from skim's beans organ

Tonic. causes hyperaemic otherwise in meninges + cortical
nervous system. Hi thickness in axis. vessels of same
lesions in nerv. cells not specific from tonic but sec. to
disturb. of blood supply.

Acid Diathesis &c.

Many kinds of meat or certain vegetables especially beans. Acids from
Certain may be formed in many veg. products

Nonne - canned beans.

Intestinum.

(*c*) ~~Meat~~ poisoning due to *Bacillus botulinus*. This is a rare form, the organism of which was discovered by van Ermengem in a ham, the eating of which had given rise to 50 cases of botulism. The symptoms resemble those of atropine poisoning—dryness of the throat, dilatation of the pupil, deafness, facial and cardio-respiratory paralysis.

Certain game birds, particularly the grouse, are poisonous in special districts and at certain seasons. It is interesting to note that mutton and lamb have thus far not been implicated as a cause of food poisoning.

Poisoning by Meat Products.—(*a*) The poisonous effects which follow the drinking of milk infected with saprophytic bacteria are considered in the section on the diarrhœa of infants.

(*b*) *Cheese Poisoning.*—Various milk products, ice cream, custard, and cheese, may prove highly poisonous. Among the poisons Vaughan now states that the tyrotoxicon "is not the one most frequently present, nor is it the most active one." In one epidemic he and Novy have isolated from cheese a substance belonging to the poisonous albumins, and in an extensive ice-cream epidemic Vaughan and Perkins found in the ice cream a highly pathogenic bacillus, but its toxin has not been separated. The symptoms are those of acute gastro-intestinal irritation.

Poisoning by Shell-fish and Fish.—(*a*) *Mussel Poisoning.*—Brieger has separated a ptomaine—mytilotoxin—which exists chiefly in the liver of the mussel. The observations of Schmidtmann and Cameron have shown that the mussel from the open sea only becomes poisonous when placed in filthy waters, as at Wilhelmshafen.

Dangerous, even fatal, effects may follow the eating of either raw or cooked mussels. The symptoms are those of an acute poisoning with profound action on the nervous system, and without gastro-intestinal manifestations. There are numbness and coldness, no fever, dilated pupils, and rapid pulse; death occurs sometimes within two hours with collapse symptoms. In an epidemic at Wilhelmshafen, Germany, in 1885, nineteen persons were attacked, four of whom died. Salkowski and Brieger isolated the *mytilotoxin* from specimens of the mussels. Poisoning occasionally follows the eating of oysters which are stale or decomposed. The symptoms are usually gastro-intestinal.

(*b*) *Fish Poisoning.*—There are two distinct varieties; in one the poison is a physiological product of certain glands of the fish, in the other it is a product of bacterial growth. The salted sturgeon used in parts of Russia has sometimes proved fatal to large numbers of persons. In the middle parts of Europe the barb is stated to be sometimes poisonous, producing the so-called "*barben cholera.*" In China and Japan various species of the *tetrodon* are also toxic, sometimes causing death within an hour, with symptoms of intense disturbance of the nervous system.

Grain and Vegetable Food Poisoning.—(*a*) *Ergotism.*—The prolonged use of meal made from grains contaminated with the ergot fungus (*claviceps purpurea*) causes a series of symptoms known as ergotism, epidemics of which have prevailed in different parts of Europe. Two forms of this chronic ergotism are described—the one, gangrenous, is believed to be due to the sphacelinic acid, the other, convulsive or spasmodic, is due to the cornutin. In the former mortification affects the extremities—usually the toes and fingers, less commonly the ears and nose. Preceding the onset of the gangrene

there are usually anæsthesia, tingling, pains, spasmodic movements of the muscles, and gradual blood stasis in certain vascular territories.

The nervous manifestations are very remarkable. After a prodromal stage of ten to fourteen days, in which the patient complains of weakness, headache, and tingling sensations in different parts of the body, perhaps accompanied with slight fever, symptoms of spasm develop, producing cramps in the muscles and contractures. The arms are flexed and the legs and toes extended. These spasms may last from a few hours to many days and relapses are frequent. In severer cases epilepsy develops and the patient may die in convulsions. Mental symptoms are common, manifested sometimes in a preliminary delirium, but more commonly, in the chronic poisoning, as melancholia or dementia. Posterior spinal sclerosis occurs in chronic ergotism. In the interesting group of 29 cases studied by Tuczek and Siemens 9 died at various periods after the infection, and four post mortems showed degeneration of the posterior columns. A condition similar to tabes dorsalis is gradually produced by this slow degeneration in the spinal cord.

(*b*) *Lathyrism* (Lupinosis).—An affection produced by the use of meal from varieties of vetches, chiefly the *Lathyrus sativus* and *L. cicera.* The grain is popularly known as the chick-pea. The grains are usually powdered and mixed with the meal from other cereals in the preparation of bread. As early as the seventeenth century it was noticed that the use of flour with which the seeds of the *Lathyrus* were mixed caused stiffness of the legs. The subject did not, however, attract much attention before the studies of James Irving, in India, who between 1859 and 1868 published several important communications, describing a form of spastic paraplegia affecting large numbers of the inhabitants in certain regions of India and due to the use of meal made from the *Lathyrus* seeds. It also produces a spastic paraplegia in animals. The Italian observers describe a similar form of paraplegia, and it has been observed in Algiers by the French physicians. The condition is that of a spastic paralysis, involving chiefly the legs, which may proceed to complete paraplegia. The arms are rarely, if ever, affected. It is evidently a slow sclerosis induced under the influence of this toxic agent. The precise anatomical condition, so far as I can ascertain, has not yet been determined.

(*c*) *Potato-poisoning.*—It has long been known that potatoes contain normally a very small amount (about 0.06 per cent.) of the poisonous principle solanin, but it is only quite recently that it has been discovered that, under certain circumstances, they may contain the poison in amounts sufficient to cause grave disturbance of the system. The increase is due to the action of at least two species of bacteria, *Bacterium solaniferum non-colorabile* and *Bacterium solaniferum colorabile,* and occurs in those tubers which, during growth, have lain partially exposed above ground, and in those which, during storage, have become well sprouted. The most extensive outbreak of potato-poisoning recorded occurred in 1899 in a German regiment, fifty-six members of which, after eating sprouted potatoes, were seized with chills, fever, headache, vomiting, diarrhœa, colic, and great prostration. Many were jaundiced and several collapsed, but all recovered. Samples of the remaining potatoes yielded 0.38 per cent. of solanin, and this would indicate that a full portion must have contained about 5 grains.

Treatment.—The source of the infection must be ascertained and the of-

not to be

after deficiency disease. ✓

The view that the disease is due to (or a) lack of some food constituent) is has much to support it. Lack of proteins has been suggested.

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fending food destroyed. The stomach should be washed out and the bowels evacuated by a brisk saline purge. Saline infusions, hypodermic or intravenous, may promote the elimination of the toxins.

VI. PELLAGRA

Definition.—A disease of unknown etiology, with periodical manifestations characterized by gastro-intestinal disturbances, skin lesions, and a tendency to changes in the nervous system.

Historical.—The disease appears to have been endemic in Spain by 1735 and the first description is by Cazal (1762), who named it *mal de la rosa*. It existed in Italy in 1750 and was described in 1771 by Frapolli, who gave it the name of pellagra (rough skin). By the eighteenth century it had spread over northern Italy and had appeared in France and in Roumania. It is quite probable that there have been sporadic cases in the United States for the last fifty years.

Distribution.—The disease is prevalent in parts of southern Europe, particularly in Italy and Roumania. There are probably 100,000 cases in Italy and 50,000 in Roumania. It exists in Spain, Portugal, France, Egypt and the United States, in the southeastern part of which country the disease has spread rapidly in the last few years. Better diagnosis can hardly explain the frequency, as the disease is so striking in its manifestations that many cases could hardly be overlooked. The reported deaths in the United States in 1908 were 23, in 1909, 116, and in 1910, 368. There is evidence that the disease is to some extent one of particular localities, as beri-beri; it is also a disease of the country more than of the cities. This applies particularly to Europe, but in the United States many of the small towns and villages show a number of cases. As regards the influence of place, the number of cases in the asylums of the United States is significant.

Etiology.—The cause of the disease is as yet unknown. There are two main views, one that it is caused by ~~something in the~~ diet, ~~in other words,~~ a food intoxication, and the other that it is due to infection of some kind. If the latter be the case the infectious agent is apparently not conveyed directly from person to person, and Sambon suggested that it may be a protozoal disease, carried by sand flies of the genus *Simulium*. There is absence of proof that the disease is communicated from one person to another. In the Italian institutions, where a large number of pellagrins are treated, no attendant has contracted the disease. If due to food intoxication, the accused article is corn (maize), comparable to the part thought to be played by rice in beri-beri. While there is no doubt that isolated cases arise in persons who have never eaten maize, yet these are sporadic instances and the geographical occurrence of the disease in endemic form very largely corresponds with the cultivation and consumption of corn. A toxic substance in the grain, present before consumption or developed afterwards, substances due to alterations in the grain, or fungi growing on it have been suggested as responsible. The association of the eating of spoiled corn with the appearance of the disease has been noted.

or a cask of some food constituent

Age.—The disease occurs at any age, but the majority of cases are between twenty and forty years. As regards races, the negro is more suscepti-

ble than the white, and, in reference to sex, women are apparently slightly more susceptible than men.

Occupation.—In Europe the disease is almost confined to laborers of the poorer classes, but this is not true of the United States.

Season.—The effect of this is very striking and the disease occurs particularly in the spring and sometimes in the autumn, both in its onset and recurrences.

Pathology.—There is nothing characteristic in the morbid anatomy. In the acute cases there may be atrophy of the walls of the intestines, fatty degeneration of the internal organs and changes in the nervous system. The alterations in the cord are fairly constant. There is degeneration of the lateral columns in the dorsal region and of the posterior columns in the cervical and dorsal regions. In the brains of patients with mental deterioration atrophy of the cerebrum is found. As regards the *pathogenesis* there are two views, one that it is a chronic disease with recurring exacerbations, the other that it is due to repeated poisoning.

Symptoms.—These vary markedly in severity, usually appearing in the spring and sometimes in the autumn. There is always a tendency to recurrence, and with each succeeding attack more damage is done, particularly to the nervous system. The onset is usually in the spring with indefinite symptoms, such as weakness, headache, and depression.

Digestive Tract.—Disturbance of the alimentary tract is usually an early symptom. In the mouth there may be sensations of heat, with loss of taste. Stomatitis is common, the mucous membrane is very red, ulcers may appear and the epithelium is stripped off, leaving a raw surface so that chewing is painful. Anorexia, nausea, vomiting and dyspeptic symptoms are common; there is also diarrhœa, often severe and accompanied by pain, the stools being serous or bloody. It may alternate with constipation.

Skin.—The erythema usually begins on the backs of the hands and at first resembles an ordinary sunburn. There may be puffy swelling. The affected areas are symmetrical and sharply defined as a rule, extending above the wrist and down to the last finger joint. The face, neck and feet may be affected in the same way. The process may not advance any further, the skin becomes darker and desquamates, after which some pigmentation remains. In other cases vesicles and bullæ form, containing serum or pus. These dry gradually, with the production of fissures. After drying and desquamation the skin may have a dry appearance and a deep red color. With repeated attacks the skin may become indurated, thickened and dark in color; later atrophy and thinning may follow. Exposure to the sun may have an influence on the eruption, but is not the cause. The erythema occurs sometimes on protected parts.

Nervous System.—Headache and vertigo are common. Mental features are often marked, among which are confusion, dullness, lassitude, irritability, feelings of anxiety and depression, change in the disposition, and hallucinations of sight and hearing. These may progress to profound depression and ultimately to dementia. Mania occurs sometimes and suicidal tendencies are not uncommon. The symptoms due to changes in the *cord* vary with the lesion. A spastic condition, disturbances of sensation, paralysis of the sphincters, or loss of the reflexes of the legs may be found.

The blood shows no special features beyond those of a secondary anæmia. The temperature is usually normal except in the acute cases in which fever occurs.

Clinical Forms.—The disease occurs in two main forms, an acute and a chronic recurrent form. In the acute form there are fever, marked prostration, severe diarrhœa, delirium or stupor and a rapid downward course. Death may occur in a few weeks from the onset. These cases seem to be more frequent in the United States than in Europe. In the chronic form the manifestations are not severe, but tend to recur each year, and each attack leaves the patient in a worse condition. There is always the tendency to mental deterioration which occurs in fully 10 per cent. of the cases. Death occurs from exhaustion and cachexia, or some intercurrent disease. Fortunately, succeeding attacks are not necessarily more severe than the preceding ones. There are instances of this form persisting for twenty-five years. Cases without the skin lesions—pellagra sine pellagra—have been described.

Diagnosis.—A typical case offers no difficulties, but in the absence of the skin lesions considerable difficulty may be experienced. Scurvy might give difficulty, but the absence of the other features of pellagra should be conclusive. Skin lesions of the nature of erythema might cause confusion, but the absence of the general features removes doubt. Sprue may be difficult to separate; in fact, some consider it a form of pellagra. The psychical features might suggest general paresis, but the skin lesions and digestive disturbance should make the diagnosis clear. The acute cases might be mistaken for various infections, but the erythema and gastro-intestinal features should prevent this.

Prognosis.—In the United States the outlook is regarded as serious, if not as regards death, certainly as regards ultimate recovery. In Europe, where the disease has existed for a long time, the prognosis is more favorable, and in Italy in some years the mortality was only 4 per cent. In cases with acute features or fever the prognosis is grave and signs of severe toxæmia or of mental involvement are ominous. Erythema of a moist character is regarded as a grave sign. Any complications should be regarded seriously. The prognosis is best in the chronic cases without mental features. The outlook is serious in asylum cases.

Prophylaxis.—"Peasant life, poverty, and polenta (corn)" have been given as the causal factors. Improvement in the living conditions and good sanitation are important points in the prevention. As to the use of corn, there can be no question of the importance of careful inspection to prevent the use of spoiled corn, particularly in institutions. There is no evidence to suggest the need of isolation of pellagrins.

Treatment.—The patient should be placed in the best general hygienic conditions and a change of climate is advisable. Rest in bed is necessary while the symptoms are acute. The diet should be as nutritious as possible and the diarrhœa need not interfere with taking sufficient nourishment. Salt should be given freely. There is no proof that we have any remedy with a specific influence. Arsenic has been given by the mouth or by injection. Atoxyl and salvarsan have been used in ordinary dosage, but arsenic by mouth, as Fowler's solution, is apparently more useful than the newer preparations given by injection. Transfusion of blood, both from healthy individuals and those who have recovered from the disease, has been done apparently with good

results in some cases. Symptomatic treatment, on the whole, seems to have been as successful as any special measure and should be carried out as demanded by the conditions in each patient.

VII. BERI-BERI

(*Kakke, Endemic Multiple Neuritis*)

Definition.—A disorder of metabolism associated with the defect of certain unknown elements of the food, and characterized clinically by multiple neuritis, anasarca, and muscular atrophy.

History.—The disease is believed to be of great antiquity in China, and is possibly mentioned in the oldest known medical treatise. In the early years of the nineteenth century it attracted much attention among the Anglo-Indian surgeons, and we may date the modern scientific study of the disease from Malcolmson's monograph, published at Madras in 1835. The opening of Japan gave an opportunity to the European physicians holding university positions, particularly Anderson, Baelz, Scheube, and more recently Grimm, to investigate the disease. The studies of the native Japanese physicians, particularly Miura and Takagi, and of the Dutch physicians in the East, have contributed much to our knowledge. The recent studies of Schaumann, Fraser, Stanton, and others and the dietetic experiments in the Philippines have confirmed the older views that it is a disorder depending upon an imperfect dietary.

Distribution.—It is specially prevalent among the Malays, Chinese and Japanese, and during the Russian war more than 50,000 cases occurred in the Japanese army. It prevails excessively in the Philippines. In India it is less common. Localized outbreaks have occurred in Australia. It prevails in parts of South America, and in the West Indies. It is met with among the fishermen of Norway and of the Newfoundland Banks. It occurs also in asylums, in which there have been severe outbreaks in the United States, and in the Richmond Asylum, Dublin, in the years 1894, 1896 and 1897 under conditions of over-crowding.

Etiology.—Two main views have prevailed: That it is an acute infection and that it is a disorder of metabolism. Numerous bacteriological studies have not determined the presence of any definite organism. On the other hand, the work of the past few years has confirmed the food theory widely held in Japan.

Studies in the Far East leave no doubt that the disease is there due to a diet of rice from which the pericarp has been removed, in what is called "polishing" or "milling." This is an old story, as the Dutch knew of the association of the disease with rice, and it was by modifying the rice diet of the sailors that Takagi eradicated beri-beri from the Japanese navy. Braddon, too, showed the importance of the retention of the pericarp for the prevention of the disease.

Schaumann's experiments, which have been amply confirmed by Fraser and Stanton, leave no question that beri-beri is associated with a diet freed from the materials existing in the pericarp. Whether these are the phosphorus

Lack of substance in alcoholic [illegible] of rice

prob. several forms of tropical multiple neuritis under beri beri.
Typhoid [illegible] Japan. dietary deficiency in vitamin. responsible
absence of pericarp + germ of rice

compounds, as Schaumann believes, or some unknown substances, as Fraser and Stanton hold, has not yet been settled.

That beri-beri occurs in ships and in institutions may be explained by the fact that in the dietary, though it may not be of rice, similar compounds are lacking. On the other hand, certain French workers in the East hold that white rice alone does not produce the disease, and that there must be some other factor, since the great majority of rice-eaters in the East are immune.

Other factors are overcrowding, as in ships, jails and asylums, hot and moist seasons, and exposure to wet. Males are more subject to the disease than females. Under good hygienic conditions Europeans rarely contract the disease.

Symptoms.—The incubation period is unknown, but it probably extends over several months. The following forms of the disease are recognized by Scheube:

(*a*) THE INCOMPLETE OR RUDIMENTARY FORM which often sets in with catarrhal symptoms, followed by pains and weakness in the limbs and a lowering of the sensibility in the legs, with the occurrence of paræsthesia. Slight œdema sometimes appears. After a time paræsthesia is felt in other parts of the body, and the patient may complain of palpitation of the heart, uneasy sensations in the abdomen, and sometimes shortness of breath. There may be weakness and tenderness of the muscles. After lasting from a few days to many months, these symptoms all disappear, but with the return of the warm weather there may be a recurrence. One of Scheube's patients suffered in this way for twenty years.

(*b*) THE ATROPHIC FORM sets in with much the same symptoms, but the loss of power in the limbs progresses more rapidly, and very soon the patient is no longer able to walk or to move the arms. The atrophy, which is associated with a good deal of pain, may extend to the muscles of the face. The œdematous symptoms and heart troubles play a minor rôle in this form, which is known as the dry or paralytic variety.

(*c*) THE WET OR DROPSICAL FORM.—Setting in as in the rudimentary variety, the œdema soon becomes the most marked feature, extending over the whole subcutaneous tissue, and associated with effusions into the serous sacs. The atrophy of the muscles and disturbance of sensation are not such prominent symptoms. On the other hand, palpitation and rapid action of the heart and dyspnœa are common. The wasting may not be apparent until the dropsy disappears.

(*d*) THE ACUTE, PERNICIOUS, OR CARDIAC FORM is characterized by threatenings of an acute cardiac failure, coming on rapidly after the existence of slight symptoms, such as occur in the rudimentary form. Death may follow within twenty-four hours; more commonly the symptoms extend over several weeks. Widespread paralysis with anæsthesia may be present.

The mortality ~~of the disease~~ varies greatly, from 2 or 3 per cent. to 40 or 50 per cent. among the coolies in certain of the settlements of the Malay Archipelago.

Morbid Anatomy.—The most constant and striking features are changes in the peripheral nerves and degenerative inflammation involving the axis cylinder and medullary sheaths. In the acute cases this is found not only in the peripheral nerves, but also in the pneumogastric and in the phrenic. The

fibres of the voluntary muscles, as well as of the myocardium, are also much degenerated.

Diagnosis.—In tropical countries there is rarely any difficulty in the diagnosis. In cases of peripheral neuritis, associated with œdema, coming from tropical ports, the possibility of this disease should be remembered.

The peculiar epidemic dropsy of Calcutta and Bengal is probably beri-beri. Greig has shown it to be a nutritional disorder associated with the use of polished rice.

Prophylaxis.—Much has been done to prevent the disease, particularly in Japan. There has been no more remarkable triumph of modern hygiene than Takagi's dietetic reforms in the Japanese navy. Everywhere in the East a change in the diet has been followed by the disappearance of the disease. In the Straits Settlements a group of men took No. 1 polished white Siam rice, and developed beri-beri within sixty days. A group that took unpolished rice remained free from the disease. By exchange of clothing, contact, living together, the disease was not conveyed from one group to the other. Then the group that had partaken of the unpolished rice was fed with polished rice, and within two months developed beri-beri.

The change of diet in the Philippine Scouts instituted on September 30th, 1909, has been followed by remarkable results. Instead of 20 ounces of highly milled rice, the amount was limited to 16 ounces of unpolished rice. The number of admissions for the disease in 1908 and 1909 in a strength of men of 5,000 was 619 and 558. In 1910 there were 50 cases, and in the first five months of 1911 only one case. Chamberlain, from whose report I quote, states that the Philippine experiments bear out at every point the polished rice theory of the ~~production of the disease~~. After having been continuously present for five years at the Culion Leper Colony in the Philippines, beri-beri disappeared entirely in nine months after the use of unpolished rice was enforced (Heiser).

Treatment.—It is a very chronic and obstinate malady. A nutritious diet, without much rice, rest in bed, purgation for the dropsy, cardiac stimulants, and the usual measures for the neuritis are the important factors in the treatment. Salicylates and saline laxatives are used in Japan. When the œdema has subsided massage, passive movements, and electricity may be used for the atrophic muscles.

SECTION IV

DISEASES OF METABOLISM

I. GOUT

(*Podagra*)

Definition.—A disorder of metabolism associated with retention of uric acid and of other purin bodies in the body, characterized clinically by attacks of acute arthritis, the deposition of sodium-biurate in and about the joints, and by the occurrence of irregular constitutional symptoms.

Etiology.—The purin bodies, adenin, guanin, hypoxanthin, xanthin, and uric acid, result from the transformation of the nucleo-proteins of the food and of the tissues by ferments or enzymes, each one of which has its own specific action. Among the proteolytic enzymes nuclease has a universal distribution, and, no matter what the source of the nucleo-protein, it sets free adenin and guanin. Specific enzymes also liberate uric acid from the nucleo-proteins of the tissues and from the purins of the food. Once formed, the difficulty is to get rid of uric acid from the system, and this appears to be one essential factor in the etiology of gout. Birds and serpents, unable to oxidize it, excrete large quantities. "All mammals, with the important exception of man, are able to destroy uric acid rapidly and in considerable quantities. This destruction is an oxidation accomplished by a specific enzyme called uricase, and the reaction seems to consist of the removal of one of the carbon atoms from the uric acid, thus converting it into the more readily soluble allantoin" (Wells). These transforming enzymes are very variously distributed in the body; nuclease is present in all cells, adenase and the xanthin enzyme are not so widely distributed. Uricase, on which the uricolytic power of the different tissues depends, is present chiefly in the liver and kidneys of mammals, and to a less degree in the muscles. Man alone seems to have a difficulty in oxidizing uric acid. Even on a purin-free diet he excretes daily a certain amount, and purin-rich food is at once followed by a rise. In other mammals it is readily oxydized into allantoin, of which human urine never contains more than a trace.

Gout, then, cannot be regarded as loss of the power of a given individual to destroy uric acid, since this does not appear to be an active function in the human body. Loss of power to eliminate favors the deposition of uric acid, and individuals who cannot get rid easily of their purins, endogenous or exogenous, may be said to be gouty.

There is a form of gout in swine, characterized by a deposit of guanin in the muscles—the chalky flakes which are so often seen in old Virginia and Westphalian hams—and it has been found that the pig's liver is deficient in

the enzyme guanase, which in other animals oxidizes this purin body. We cannot say yet how great is the part played by uric acid in human gout and how much by the other purin bodies, but recent work favors the view that imperfect elimination rather than imperfect oxidation of the purin bodies is the chief factor in the disease.

The normal daily output of uric acid is from 0.04 to 1.0 gm., and it is greater by day than by night. The amount from the intake of the exogenous oxy-purins varies from 40 to 60 per cent. of the total purin content. The more active the functions of the body the greater the discharge. Severe exertion, fever and exposure to cold increase the output. The amount is greatly influenced by food, particularly when rich in purin bases. For example, after a meal containing sweetbread the amount may be doubled. In gouty persons the output is low, and I have had cases of tophaceous gout in which, in the intervals between the attacks, the excretion was nil (Futcher). With the onset of an attack the output rises, and the phosphoric acid is also greatly increased, as shown in Chart XIV.

PREDISPOSING FACTORS.—Heredity is important. In from 50 per cent. to 60 per cent. of all cases the disease existed in the parents or grandparents, and the transmission is more marked on the male side. Males are more subject than females. It is rarely seen before the thirtieth year, though cases have occurred before puberty, and even in infants at the breast.

Alcohol is an important factor in the etiology. Fermented liquors are more apt to cause it than distilled spirits, and the disease is much more common in England and in Germany, the countries which consume the largest amount of beer *per capita*. The disease is common in the United States, and is perhaps on the increase. As Futcher pointed out, gout is only one-third less frequent at the Johns Hopkins Hospital than at St. Bartholomew's Hospital, London. Among 18,000 patients in my wards there were 59 cases of gout; all but three in whites, and all in males but two (Futcher).

Food plays a rôle of importance equal to alcohol. Overeating without active exercise is a special predisposing cause. But the disease is by no means confined to the well-to-do. A combination of poor food, defective hygiene and the excessive consumption of malt liquors makes "poor man's gout" not infrequent.

Occupation is of great importance, and the disease is much more common in workers in breweries, and in persons who deal in any way with alcohol.

It is not uncommon in persons of great mental and bodily vigor. Among distinguished members of our profession who have been terrible sufferers were the elder Scaliger, Jerome Cardan and Sydenham. The statement of the latter, however, that "more wise men than fools are victims" of the affection, does not hold good to-day. The celebrated Pirckheimer wrote a famous "Apology for Gout" (1521), and there is much truth in what Podagra says: "For I take no pleasure in those hard, rough, rusticke, agresticke kind of people, who never are at rest, but always exercise their bodies with hard labors, are ever moyling and toyling, do seldom or never give themselves to pleasure, do endure hunger, which are content with a slender diet." (English Edition, 1617.)

Among the directly EXCITING CAUSES of an attack may be mentioned a meal with large quantities of rich food and too much to drink; worry, or a

sudden mental shock, and in sensitive persons a slight injury or accident may be followed by acute arthritis.

Morbid Anatomy.—The *blood* contains an excess of uric acid. It may be obtained from the blood-serum by the method known as Garrod's uric-acid thread experiment, or from the serum obtained from a blister. To 3 ij of

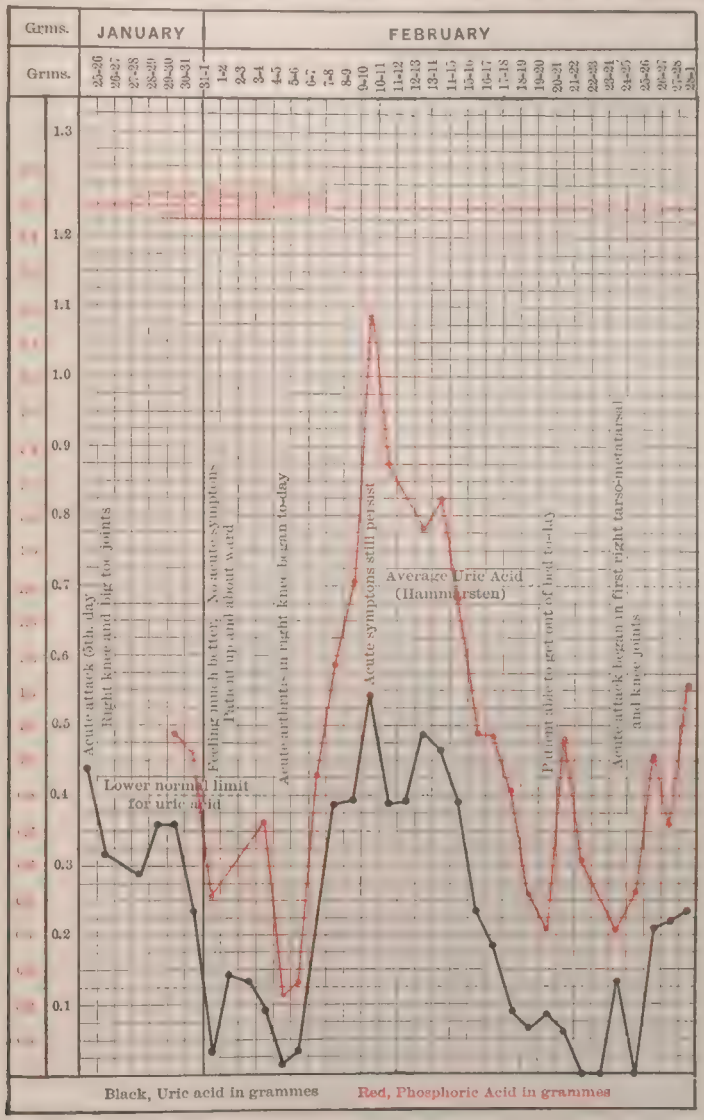

CHART XIV.—URIC ACID AND PHOSPHORIC ACID OUTPUT IN CASE OF ACUTE GOUT.

serum add ♏ v-vj of acetic acid in a watch-glass. A thread immersed in this may show in a few hours an incrustation of uric acid. The experiment is rarely successful even in cases of manifest gout. This excess, also, is not peculiar to gout, but occurs in leukæmia and chlorosis. The red cells in the "lead-gout" cases may show basophilic granular staining.

The important changes are in the articular tissues. The first joint of the great toe is most frequently involved; then the ankles, knees, and the small joints of the hands and wrists. The deposits may be in all the joints of the lower limbs and absent from those of the upper limbs (Norman Moore). If death takes place during an acute paroxysm, there are signs of inflammation, hyperæmia, swelling of the ligamentous tissues, and of effusion into the joint. The primary change, according to Ebstein, is a local necrosis, due to the presence of an excess of urates in the blood. This is seen in the cartilage and other articular tissues in which the nutritional currents are slow. In these areas of coagulation necrosis the reaction is always acid and the neutral urates are deposited in crystalline form, as insoluble acid urate. The articular cartilages are first involved. The gouty deposit may be uniform, or in small areas. Though it looks superficial, the deposit is invariably interstitial and covered by a thin lamina of cartilage. The deposit is thickest at the part most distant from the circulation. The ligaments and fibro-cartilage ultimately become involved and are infiltrated with biurate deposits, the so-called chalk-stones, or tophi. These are usually covered by skin; but in some cases, particularly in the metacarpo-phalangeal articulations, this ulcerates and the chalk-stones appear externally. The synovial fluid may also contain crystals. In very long-standing cases, owing to an excessive deposit, the joint becomes immobile. The marginal outgrowths in gouty arthritis are true exostoses (Wynne). The cartilage of the ear may contain tophi, which are seen as whitish nodules at the margin of the helix. The cartilages of the nose, eyelids, and larynx are less frequently affected.

Of changes in the internal organs those in the renal and vascular systems are the most important. The kidney changes believed to be characteristic of gout are: (*a*) A deposit of urates chiefly in the region of the papillæ. This, however, is less common than is usually supposed. Norman Moore found it in only 12 out of 80 cases. The apices of the pyramids show lines of whitish deposit. Ebstein has described and figured areas of necrosis in both cortex and medulla, in the interior of which were crystalline deposits of urate of soda. (*b*) An interstitial nephritis, either the ordinary "contracted kidney" or the arterio-sclerotic form, neither of which is in any way distinctive.

The metatarso-phalangeal joint of the big toe should be carefully examined, as it may show typical lesions of gout without any outward token of arthritis.

Arterio-sclerosis and cardiac hypertrophy are very constant lesions. Concretions of urate of soda may occur on the valves. Myocarditis is common.

Changes in the respiratory system are rare. Deposits have been found in the vocal cords, and uric-acid crystals have been found in the sputum of a gouty patient (J. W. Moore).

Symptoms.—Gout is usually divided into acute, chronic, and irregular forms.

Acute Gout.—Premonitory symptoms are common—twinges of pain in the small joints of the hands or feet, nocturnal restlessness, irritability of temper, and dyspepsia. The urine is acid, scanty, and high-colored. It deposits urates on cooling, and there may be transient albuminuria. There may be traces of sugar (gouty glycosuria). Before an attack the output of

uric acid is low and is also diminished in the early part of the paroxysm. The relation of uric and phosphoric acids to the acute attacks is well represented in Chart XIV, prepared by Futcher. Both are extremely low in the intervals, but reach normal limits shortly after the onset of the acute symptoms. The phosphoric acid and uric acid show almost parallel curves. The patient was on a very light fixed diet at the time the determinations were made. In some instances the throat is sore, and there may be asthmatic symptoms. The attack sets in usually in the early morning hours. The patient is aroused by a severe pain in the metatarso-phalangeal articulation of the big toe, and more commonly on the right than on the left side. The pain is agonizing, and, as Sydenham says, "insinuates itself with the most exquisite cruelty among the numerous small bones of the tarsus and metatarsus, in the ligaments of which it is lurking." The joint swells rapidly, and becomes hot, tense, and shiny. The sensitiveness is extreme, and the pain makes the patient feel as if the joint were being pressed in a vice. There is fever, and the temperature may rise to 102° to 103° F. Toward morning the severity of the symptoms subsides, and, although the joint remains swollen, the day may be passed in comparative comfort. The symptoms recur the next night, and the fit, as it is called, usually lasts for from five to eight days, the severity of the symptoms gradually abating. There is usually a moderate leucocytosis during the acute manifestations. Occasionally other joints are involved, particularly the big toe of the opposite foot. The inflammation, however intense, never goes on to suppuration. With the subsidence of the swelling the skin desquamates. The tarsus alone may be involved and so obstinate may be the inflammation that the question of surgical interference may be raised in the belief that it is tuberculous or suppurative. After the attack the general health may be much improved. As Aretæus remarks, a person in the interval has won the race at the Olympian games. Recurrences are frequent. Some patients have three or four attacks in a year; others suffer at longer intervals.

The term *retrocedent* or *suppressed* gout is applied to serious internal symptoms, coincident with a rapid disappearance or improvement of the local signs. Very remarkable manifestations may occur under these circumstances. The patient may have severe gastro-intestinal symptoms—pain, vomiting, diarrhœa, and great depression—and death may occur during such an attack. Or there may be cardiac manifestations—dyspnœa, pain, and irregular action of the heart. In some instances, in which the gout is said to attack the heart, an acute pericarditis proves fatal. So, too, there may be marked cerebral manifestations—delirium or coma, and even apoplexy—but in a majority of these instances the symptoms are, in all probability, uræmic.

Chronic Gout.—With increased frequency in the attacks, the articular symptoms persist for a longer time, and gradually many joints become affected. Deposits of urates take place, at first in the articular cartilages and then in the ligaments and capsular tissues; so that in the course of years the joints become swollen, irregular, and deformed. The feet are usually first affected, then the hands. In severe cases there may be extensive concretions about the elbows and knees and along the tendons and in the bursæ. The tophi appear in the ears. Finally, a unique clinical picture is produced which can not be mistaken for that of any other affection. The skin over the tophi may

rupture or ulcerate, and about the knuckles the chalk-stones may be freely exposed. Patients with chronic gout are usually dyspeptic, often of a sallow complexion, and show signs of arterio-sclerosis. The pulse tension is increased, the vessels are stiff, and the left ventricle is hypertrophied. The urine is increased in amount, is of low specific gravity, and usually contains a slight amount of albumin, with a few hyaline casts. Severe cramps involving the calf, abdominal, and thoracic muscles are common. Intercurrent attacks of acute polyarthritis may occur, in which the joints become inflamed, and the temperature ranges from 101° to 103° F. There may be pain, redness, and swelling of several joints without fever. Uræmia, pleurisy, pericarditis, peritonitis, and meningitis are common terminal affections.

Irregular Gout.—This is a motley, ill-defined group of symptoms, manifestations of a condition of disordered nutrition, to which the terms *gouty diathesis* or *lithæmic state* have been given. Cases are seen in members of gouty families, who may never themselves have suffered from the acute disease, and in persons who have lived not wisely but too well, who have eaten and drunk largely, lived sedentary lives, and yet have been fortunate enough to escape an acute attack. It is interesting to note the various manifestations of the disease in a family with marked hereditary disposition. The daughters often escape, while one son may have gouty attacks of great severity, even though he lives a temperate life and tries in every way to avoid the conditions favoring the disorder. Another son has, perhaps, only the irregular manifestations and never the acute articular affection. While the irregular features are perhaps more often met with in the hereditary affection, they are by no means infrequent in persons who appear to have acquired the disease. The tendency in some families is to call every affection gouty. Even infantile complaints, such as scald-head, naso-pharyngeal vegetations, and enuresis, are often regarded, without sufficient grounds, as evidences of the family ailment. Among the commonest manifestations of irregular gout are the following:

(*a*) *Cutaneous Eruptions.*—Garrod and others have called special attention to the frequent association of eczema with the gouty habit.

(*b*) *Gastro-intestinal Disorders.*—Attacks of what is termed "biliousness," in which the tongue is furred, the breath foul, the bowels constipated, and the action of the liver torpid, are not uncommon in gouty persons. A gouty parotitis is described.

(*c*) *Cardio-vascular Symptoms.*—With gout arterio-sclerosis is frequently associated. The blood tension is persistently high, the vessel walls become stiff, and cardiac and renal changes gradually occur. In this condition the symptoms may be renal, as when the albuminuria becomes more marked, or dropsical symptoms supervene. The manifestations may be cardiac, when the hypertrophy of the left ventricle fails and there are palpitation, irregular action, and ultimately a condition of asystole. Or, finally, the manifestations may be vascular, and thrombosis of the coronary arteries may cause sudden death, or, as most frequently happens, a blood-vessel gives away in the brain, and the patient dies of apoplexy. It makes but little difference whether we regard this condition as primarily an arterio-sclerosis or as a gouty nephritis; the point to be remembered is that the nutritional disorder with which an excess of uric acid is associated induces in time increased tension, arterio-sclerosis, chronic interstitial nephritis, and changes in the myocardium. Pericar-

ditis is not an infrequent terminal complication of gout. Phlebitis is a troublesome and not very uncommon complication. It may arise in connection with varicose veins of the legs or it may occur in many venous districts in succession or simultaneously.

(*d*) *Nervous Manifestations.*—Headache and migraine attacks are not infrequent. Neuralgias, sciatica, and paræsthesias are not uncommon. A common gouty manifestation, upon which Duckworth has laid stress, is the occurrence of hot or itching feet at night. Plutarch mentions that Strabo called this symptom "the lisping of the gout." Cramps in the legs may also be very troublesome. Hutchinson has called attention to hot and itching eyeballs. Associated or alternating with this symptom there may be attacks of episcleral congestion. Apoplexy is a common termination of gout. Meningitis may occur, usually basilar.

(*e*) *Urinary Disorders.*—The urine is highly acid and high-colored, and may deposit on standing crystals of uric acid. Transient and temporary increase in this ingredient cannot be regarded as serious. In many cases of chronic gout the amount may be diminished, and increased only at certain periods, forming the so-called uric-acid showers. A sediment of uric acid in a urine does not necessarily mean an excess. It is often dependent on the inability of the urine to hold it in solution. Sugar is found intermittently in the urine of gouty persons—gouty glycosuria. It may pass into true diabetes, but is usually very amenable to treatment. Oxaluria may also be present. Gouty persons are specially prone to calculi, Jerome Cardan to the contrary, who reckoned freedom from stone among the chief of the *dona podagræ.* Minute quantities of albumin are very common in persons of gouty dyscrasia, and, when the renal changes are well established, tube-casts. Urethritis, with a purulent discharge, may arise, so it is stated, usually at the end of an attack. It may occur spontaneously, or follow a pure connection.

(*f*) *Pulmonary Disorders.*—There are no characteristic changes, but chronic bronchitis occurs with great frequency in persons of a gouty habit.

(*g*) Of eye affections, iritis, glaucoma, hæmorrhagic retinitis, and suppurative panophthalmitis have been described.

Diagnosis.—Recurring attacks of arthritis, limited to the big toe or to the tarsus, occurring in a member of a gouty family, or in a man who has lived too well, leave no question as to the nature of the trouble. There are many cases of gout, however, in which the feet do not suffer most severely. After an attack or two in one toe, other joints may be affected, and it is just in such cases of polyarthritis that the difficulty in diagnosis is apt to arise. I have had cases admitted for the third or fourth time with involvement of three or more of the larger joints. The presence of tophi has settled the nature of a trouble which in the previous attacks had been regarded as rheumatic. The following are suggestive points in such cases: (1) The patient's habits and occupation. In the United States the brewery men and barkeepers are often affected. (2) The presence of tophi. The ears should always be inspected in a case of polyarthritis. The diagnosis may rest with a small tophus. The student should learn to recognize, on the ear margin, Woolner's tip, fibroid nodules, and small sebaceous tumors. The last are easily recognized microscopically. The needle-shaped sodium biurate crystals are distinctive of the tophi. (3) The condition of the urine. As shown in Chart

XIV, the uric-acid output is usually very low during the intervals of the paroxysm. At the height of the attack the elimination, as a rule, is greatly increased. The ratio of the uric acid to the urea excretion is disturbed in gouty cases, and may fall as low as 1 to 100 or 1 to 150. (4) The gouty polyarthritis may be afebrile. A patient with three or four joints red, swollen, and painful in rheumatic fever has pyrexia, and, while it may be present and often is in gout, its absence is, I think, a valuable diagnostic sign. Many cases go a-begging for a diagnosis. A careful study of the patient's habits as to beer drinking, of the location of the initial arthritic attacks, and the examination for tophi in the ears will prevent many cases being mistaken for rheumatic fever or arthritis deformans. Lastly, in ~~these~~ doubtful forms of arthritis a careful study of the purin metabolism ~~will~~ give important information.

Prognosis.—"Once gouty, always gouty" is usually true, but by care the frequency and intensity of attacks can be much reduced. As regards the duration of life, the state of the circulation and kidneys is the most important factor.

Treatment.—Hygienic.—Individuals who have inherited a tendency to gout, or who have shown any manifestations of it, should live temperately, abstain from alcohol, and eat moderately. An open-air life, with plenty of exercise and regular hours, does much to counteract an inborn tendency to the disease. The skin should be kept active: if the patient is robust, by the morning cold bath with friction after it; but if he is weak or debilitated the evening warm bath should be substituted. An occasional Turkish bath ~~with active shampooing~~ is very advantageous. The patient should dress warmly, avoid rapid alterations in temperature, and be careful not to have the skin suddenly chilled.

Dietetic.—With few exceptions, persons over forty eat too much, and the first injunction to a gouty person is to keep his appetite within reasonable bounds, to eat at stated hours, and to take plenty of time at his meals. In the matter of food, quantity is a factor of more importance than quality with many gouty persons. As Sir William Roberts well says, "Nowhere perhaps is it more necessary than in gout to consider the man as well as the ailment, and very often more the man than the ailment."

The weight of opinion leans to the use of a modified nitrogenous diet, without excess in starchy and saccharine articles of food. Animal foods rich in nuclear material, such as sweetbreads, liver, kidneys, and brain, should be avoided. Beef extracts are injurious, owing to their richness in extractives belonging to the xanthin group. Milk and eggs are particularly useful, owing to their not containing any nuclein. Fresh vegetables and fruits may be used freely, but ~~among the latter~~ strawberries and bananas should be avoided.

Ebstein urges strongly the use of fat in the form of good fresh butter, from 2½ to 3½ ounces in the day. He says that stout gouty subjects not only do not increase in weight with plenty of fat in the food, but that they acutally become thin and the general condition improves very much. Hot bread of all sorts and the various articles of food prepared from Indian corn should, as a rule, be avoided. Roberts advised gouty patients to restrict as far as practicable the use of common salt with their meals, since the sodium

may|

id|

biurate very readily crystallizes out in tissues with a high percentage of sodium salts.

In this matter of diet each individual case must receive separate consideration.

There are very few conditions in the gouty in which ~~stimulants of~~ alcohol in any sort ~~are~~ required. Whenever indicated, whisky will be found perhaps the most serviceable. While all are injurious to these patients, some are much more so than others, particularly malted liquors, champagne, port, and a very large proportion of all the light wines.

Mineral Waters.—All forms may be said to be beneficial in gout, as the main element is the water, and the ingredients are usually indifferent. Much of the humbuggery in the profession still lingers about mineral waters, more particularly about the so-called lithia waters.

The question of the utility of alkalies in the treatment of gout is closely connected with this subject of mineral waters. This deep-rooted belief in the profession was rudely shaken a few years ago by Sir William Roberts, who claimed to have shown conclusively that alkalescence as such has no influence whatever on the sodium biurate. The sodium salts are believed by this author to be particularly harmful, but, in spite of all the theoretical denunciation of the use of the sodium salts in gout, the gouty from all parts of the world flock to those very Continental springs in which these salts are most predominant.

Of the mineral springs best suited for the gouty may be mentioned, in the United States, those of Saratoga, Bedford, and the White Sulphur; Buxton and Bath, in England; in France, Aix-les-Bains and Contrexeville; and in Germany, Carlsbad, Wildbad, Homburg, and Marienbad. Excellent results are claimed for ~~these~~ mineral waters with special radio-active properties.

The efficacy in reality is in the water, in the way it is taken, on an empty stomach, and in large quantities; and, as every one knows, the important accessories in the modified diet, proper hours, regular exercises, with baths, douches, etc., play a very important rôle in the "cure."

Medical Treatment.—In an acute attack the limb should be elevated and the affected joint wrapped in cotton-wool. Warm fomentations, or Fuller's lotion, may be used. The local hot-air or passive hyperæmia treatment may be tried. A brisk mercurial purge is always advantageous at the outset. The wine or tincture of colchicum, in doses of 20 to 30 minims (1.2 to 2 c. c.) may be given every four hours in combination with the citrate of potash or the citrate of lithium. The action of the colchicum should be carefully watched; its effect is most marked when free purgation follows. It has in a majority of the cases a powerful influence over the symptoms—relieving the pain, and reducing, sometimes with great rapidity, the swelling and redness. It should be promptly stopped so soon as it has relieved the pain. In cases in which the pain and sleeplessness are distressing and do not yield to colchicum morphia is necessary. The patient should be placed on a diet chiefly of milk and barley-water, but if there is any debility, ~~strong~~ broths or eggs may be given. ~~It is occasionally necessary to give small quantities of stimulants.~~ During convalescence meats and fish and game may be taken, and gradually the patient may resume the diet previously laid down.

In some of the subacute intercurrent attacks of arthritis sodium salicylate or aspirin is occasionally useful.

The chronic and irregular forms of gout are best treated by the dietetic and hygienic measures already referred to. Potassium iodide is sometimes useful, and preparations of guaiacum, quinine, and the bitter tonics combined with alkalies are undoubtedly of benefit.

Piperazin has been much lauded as an efficient aid in the solution of uric acid. The clinical results, however, are very discordant. It may be employed in doses of from 15 to 30 grains in the day, and is conveniently given in aërated water containing 5 grains to the tumblerful. Piperazin, as a uric acid solvent, was rapidly followed by lysidin, urotropin, urea, and urol among others—a sure indication of their therapeutic worthlessness.

Albu speaks favorably of lemon-juice as a remedy. The vegetable acids are converted in the system into alkaline carbonates, thus enabling the blood to keep the uric acid compounds in solution, and consequently facilitating their elimination by the kidneys.

Where the arthritic attacks are confined to one joint, such as the great-toe joint, surgical interference may be considered. Riedel reports two successful cases in which he removed the entire joint capsule of the big-toe joint, with permanent relief.

II. DIABETES MELLITUS

(*Disturbances of the Carbohydrate Metabolism*)

Definition.—A syndrome due to disturbance in the carbohydrate metabolism from various causes, in which sugar appears in the urine, either as a slight and transient condition (Glycosuria), or as a more severe form associated with thirst, polyuria, wasting and imperfect oxidation of the fats (Diabetes).

History.—The disease was known to Celsus. Aretæus first used the term diabetes, calling it a wonderful affection "melting down the flesh and limbs into urine." He suggested that the disease got its name from the Greek word signifying a syphon. Willis in the seventeenth century gave a good description and recognized the sweetness of the urine "as if there has been sugar and honey in it." Dobson in 1776 demonstrated the presence of sugar, and Rollo in 1797 wrote an admirable account and recommended the use of a meat diet. The modern study of the disease dates from Claude Bernard's demonstration of the glycogenic function of the liver in 1857.

Etiology.—The enzymes of the intestinal mucosa convert the starches and sugars of the food into monosaccharides—dextrose, galactose and levulose—which pass into the portal circulation, but the major portion remains in the liver, where it is converted into glycogen. The percentage of sugar in the systemic blood remains constant—0.05 to 0.15 per cent. Part of the sugar passes to the muscles, where it is stored as glycogen. The total storage capacity of the liver is estimated at about one-tenth of its weight, *i. e.*, about 150 gms. for an ordinary organ weighing 1,500 gms. Not all of the glycogen comes from the carbohydrates, a small part in health is derived from the proteins and fats. This treble process of transformation, storage and retransformation of the sugars is effected by special enzymes, which are fur-

In some cases ketonuria is marked

Renal diabetes - is "glycosuria without hyperglycaemia"
(a) sugar excretion is independent of carbohydrate intake
(b) blood sugar is normal or decreased
(c) clinical course must be followed for a long time to exclude D. mellitus

Mechanism reg. blood sugar very susceptible to acid-base equilibrium = acidosis or alkalosis
acidosis tends to increase amount of blood sugar.
alkalosis has opposite effect - tendency sugar excretion in hyperglycaemia is very.
In diabetes - usual diet - tend. is favor acidosis. Do? q.s. alkalosis with Sod. Bicarb.
Treatment: upto 120 gm. of Sod. Bicarb. administered 7 separate doses during day. Well given dissolved in a little water - teaspoonful water added.

Endocrinal disturbance may cause slight transp. glycosuria in healthy. It may be a factor in diabetes.

normal - vicinity
Newburgh 0.76

Blood sugar - In pathol. not elevated - 0.26 ave. (0.76 to 0.16)
over 0.30 - very rare unless diabetes or excretion
affects. ave 0.29.

Stimulation of suprarenal, thyroid pituitary
and excretion of pancreas.

by sympathetic nerves | diff.

Sugar metabolism main. complex apparatus of. esp. in
liver, pancreas.

The threshold stimulus of the kidney for sugar excretion
varies widely in diff. individuals and the same also differs

nished by internal secretions, chiefly of the pancreas and hypophysis, and are directly influenced by the nervous system. According to Claude Bernard the sugar is simply warehoused on demand in the liver, and given out to the muscles which need it in their work. On the other hand, Pavy maintained that the glycogen was not converted into sugar, but into fat, and also helped to build up the proteins. In any case, the sugar, one of the chief fuels of the body, is burned up, supplying energy to the muscles, and is eliminated as CO_2 and water. The nature of the intermediate stages of the transformation is still under discussion.

The following are the conditions which influence the appearance of sugar in the urine:

(*a*) Excess of Carbohydrate Intake.—As mentioned, in a normal state the sugar in the blood is never above 0.15 per cent. Once past this point, the hyperglycæmia is immediately manifested by the appearance of sugar in the urine. The healthy person has a definite limit of carbohydrate assimilation; the total storage capacity for glycogen is estimated at about 300 gms. Following the ingestion of enormous amounts of carbohydrates the liver and the muscles may not be equal to the task of storing it; the blood content of sugar passes beyond the 0.15 or 0.2 per cent. limit and the cells of the renal epithelium immediately begin to get rid of the surplus. Like the balance at the Mint, which is sensitive to the correct weight of the gold coins passing over it, they only react at a certain point of saturation. Fortunately excessive quantities of pure sugar itself are not taken. The carbohydrates are chiefly in the form of starch, the digestion and absorption of which take place slowly, so that this so-called alimentary glycosuria very rarely occurs, though enormous quantities may be taken. The assimilation limit of a normal fasting individual for sugar itself is about 250 gms. of grape sugar, and considerably less of cane and milk sugar. Clinically one meets with many cases in which glycosuria is present as a result of excessive ingestion of carbohydrates, particularly in stout persons and heavy feeders—so-called lipogenic diabetes—a form very readily controlled.

(*b*) Disturbances in the Nervous System.—Bernard shows that there was a centre in the medulla—the diabetic centre—puncture of which is followed by hyperglycæmia due to an increased outflow of sugar from the liver warehouse. He demonstrated that the efferent path of this influence was through the splanchic nerves and the afferent through the vagi. The exact location of this centre has never been determined, and its precise rôle in the carbohydrate metabolism is obscure. Clinically, however, it has long been known that many lesions of the nervous system cause glycosuria—tumors, particularly those in the neighborhood of the medulla, injuries both to the brain and to the upper part of the spinal cord, meningitis, and hæmorrhage. Some of these may disturb Claude Bernard's centre in the medulla, but, as will be mentioned later, a great many of them disturb the internal secretion of the hypophysis. Clinically, glycosuria arising from disturbances in the nervous system is not a very important variety.

(*c*) Disturbances of the Internal Secretions.—The part played in the carbohydrate metabolism by the ductless glands is of the first importance. Though not yet fully understood, the following are the chief points, so far as they bear on clinical work:

(1) *Pancreatic Secretion.*—Extirpation of the pancreas in a dog is followed by hyperglycæmia and prolonged glycosuria, which is not relieved by feeding pancreas to the animal, but which is checked if experimentally a portion of healthy organ from another dog is inserted into the portal circulation. The pancreas contains structures known as "the islands of Langerhans," which, from the work of Opie and others, are believed to furnish an internal secretion necessary to normal carbohydrate metabolism. A portion of the organ separated from the rest, and its duct ligated, atrophies, but a tissue remains composed of enlarged islands of Langerhans. If the remainder of the pancreas be removed, this atrophied portion is able to ward off glycosuria; but if this is removed glycosuria appears immediately (W. G. MacCallum). In some way the secretion furnished by this organ is essential to the proper preparation of the sugars. Cohnheim suggests a correlation of this internal secretion with a muscle enzyme, to which it acts as an ambocepter, and that it is by the combined action of these two glycolytic bodies that the sugars are normally burned up in the muscles. Many diseases of the pancreas are associated with glycosuria, some with permanent diabetes. Hæmorrhagic pancreatitis, cancer, calculus, chronic interstitial pancreatitis, catarrh of the ducts may all be associated with a profound disturbance in the metabolism of the sugars. In fact, there is no one organ the disease of which is more constantly associated with glycosuria, and the studies of Opie warrant the belief that the essential factor is a disturbance of the function of the internal secretion provided by the islands of Langerhans.

(2) *Hypophysis.*—It was long known that glycosuria occurred in tumors of the region of the hypophysis, particularly in acromegaly, and it follows fractures of the base of the skull. Experimentally, Cushing and his students have shown that the posterior lobe of the pituitary gland has an important influence in carbohydrate metabolism. The secretion of this portion of the gland is discharged into the third ventricle, and any operative disturbance of it, or of the infundibulum, is at once followed by glycosuria, and by a remarkable lowering of the assimilation limit for sugars. On the other hand, a deficiency of this secretion, or the removal of this portion of the gland alone, is followed by a remarkable increased tolerance for carbo-hydrates.

Clinically, this sequence is not infrequently seen. A tumor which at first irritates the gland, as in the early stages of acromegaly, may cause glycosuria, but later, as the posterior lobe of the gland is destroyed, there is an extraordinarily high assimilation limit for sugars, and associated with it a great increase in the deposition of fat in the body, a syndrome to be referred to later. Intravenous or subcutaneous injection of the extract of the posterior lobe promptly lowers this high assimilation limit for carbohydrates.

(3) *Adrenals and Thyroids.*—We have less positive information about the relation of carbohydrate metabolism to the internal secretions of these glands. Glycosuria does not necessarily follow lesions of the adrenals, but experimentally it has been shown that adrenalin has a powerful influence on the carbohydrate metabolism, and glycosuria may be readily produced in animals by subcutaneous injection, and by the local application of adrenalin to the pancreas. Clinically, we know practically nothing of an adrenal glycosuria. It does not occur in Addison's disease. It has occasionally been noticed in the prolonged therapeutic use of adrenalin. In disturbances of the

Blood methods

[illegible]. J. a. chem. Aug 11. 17

Blood lipoids in diseases. Average in normal 0.59%. In 32 cases diabetics - 0.83%. In 37 cases arteriosclerosis 0.51% In 35 cases cancer [illegible]

1900 sans [illegible]

1914 - 16.2 [illegible]

thyroid gland glycosuria is not uncommon. There is a lowered tolerance for sugar in Graves' disease which is sometimes associated with a true diabetes, and in the remarkable instances of acute myxœdema the amount of sugar in the urine may be large. The use of thyroid extract is occasionally followed by glycosuria. On the other hand, patients may take the extract continuously for many years without the appearance of sugar in the urine.

Possibly the glycosuria associated with pregnancy is due to a disturbance in the internal secretions at this period. It is a transient condition, usually disappearing with parturition, and rarely leads to diabetes. I have known it to recur in successive pregnancies.

(*d*) Disturbances in the Function of the Liver.—One of the most remarkable features in carbohydrate metabolism is that the great warehouse of the sugars may be damaged to any degree without causing hyperglycæmia or glycosuria. Whether or not there is a type of disease to which the name of "liver diabetes" may be given is doubtful. There are cases of cirrhosis of the liver and of gallstones—particularly those associated with enlargement of the organ—in which glycosuria is present, but they are probably all associated with coincident affections of the pancreas. In the "bronze diabetes," which is accompanied by great hypertrophy of the liver, the glycosuria is probably pancreatic.

(*e*) Disturbances in the Kidney Functions.—Disease of the kidneys is rarely associated with glycosuria. Occasionally one finds it in chronic Bright's disease, but the existence of a true diabetes depending upon changes in the kidneys has not been proved. There is a remarkable experimental diabetes of great interest in connection with carbohydrate metabolism. If phloridzin, a glucoside prepared from the bark of the apple-tree, is given by mouth or subcutaneously to man or animals glycosuria results, and even continues on a nitrogenous diet, and in man when fasting. The amount of sugar excreted may be large, yet there is no hyperglycæmia. It seems that the sugar is directly manufactured by the kidney epithelium, and largely from the proteins.

(*f*) Miscellaneous Disturbances.—The carbohydrate metabolism may be upset in acute fevers, in many of which a transient glycosuria is present. It is not uncommon after the administration of ether, less so after chloroform. Metabolic disturbances in gout are not infrequently associated with glycosuria, and cachexias and profound anæmias may be accompanied by transient glycosuria. A mental shock, a severe nervous strain and worry precede many cases. Patients suffocated by smoke, or poisoned by coal gas, may have sugar in the urine.

Incidence.—According to statistics diabetes appears to be about as frequent in the United States as in European countries. In England and Wales the death-rate from diabetes is about 9 per 100,000 of population. The disease is on the increase in the United States. The statistics for 1870 gave 2.1; for 1880, 2.8; for 1890, 3.8; for 1900, 9.3; and for 1910, 14.9 deaths to the 100,000 population. This apparent increase may be in part due to more accurate vital statistics records. Among 27,618 patients admitted to the medical wards of the Johns Hopkins Hospital in twenty-two years there were 276 cases of diabetes, or one per cent.

Hereditary influences play an important rôle and cases are on record

of its occurrence in many members of the same family. Morton, who calls the disease *hydrops ad matulam* (Phthisiologia, 1689), records a remarkable family in which four children were affected, one of which recovered on a milk diet and diascordium. An analysis of the cases in my series gave only 6 cases with a history of diabetes in relatives (Pleasants). Naunyn obtained a family history of diabetes in 35 out of 201 private cases, but in only 7 of 157 hospital cases. There are instances of the coexistence of the disease in man and wife. Among 516 married pairs collected by Senator, in which either husband or wife was diabetic, in 18 cases the second partner had become diabetic. It is not easy to explain this conjugal diabetes. The suggestion of contagion seems scarcely tenable.

Sex.—Men are more frequently affected than women, the ratio being about three to two. Of the 276 cases of diabetes above referred to 179 were in males and 97 in females (Futcher). It is a disease of adult life; a majority of the cases occur from the third to the sixth decade. Of the 276 cases, the largest number—70, or 25 per cent.—occurred between fifty and sixty years of age.

Diabetes in Children.—Stern has analyzed 117 cases in children. They usually occur among the better classes. Six were under one year of age. Hereditary influences were marked. The course of the disease is, as a rule, much more rapid than in adults. The shortest duration was two days, and in 7 cases it did not last a month. One case is mentioned of a child apparently born with glycosuria, who recovered in eight months.

In the above series there were 2 cases in the first hemi-decade, 5 in the second, and 24 in the second decade.

Persons of a neurotic *temperament* are often affected. It is a disease of the higher classes. Van Noorden states that the statistics for London and Berlin show that the number of cases in the upper ten thousand exceeds that in the lower hundred thousand inhabitants.

Race.—Hebrews seem especially prone to it; one-fourth of Frerichs' patients were of the Semitic race. I have been much impressed with the frequency of the disease among them. Diabetes is comparatively rare in the colored race, but not so uncommon as was formerly supposed. Of the series of 276 cases, 29, or 10.6 per cent., were in negroes.

Metabolism in Diabetes.—Glycosuria, neurotic, dietetic or toxic, may be a matter of simple overflow, but the essence of true diabetes is a waste of the carbohydrates, which hurry through the body, in great part never warehoused as glycogen. Why this should be, whether the liver and muscles are at fault in refusing to transform the carbohydrate, or whether the defect is the enzymes of the ductless glands, are problems awaiting solution. Naunyn held that hyperglycæmia is due to a failure of the liver and muscles to store up glycogen as in health. On the other hand, Lépine, Opie, and others support the view that the glycolitic ferments are lacking—the former may depend on the latter. In either case the result is a failure of the normal oxidation of the carbohydrates. Hyperglycæmia is responsible for the thirst and the polyuria, and there is a very considerable daily loss of energy in warming the liquids taken to the temperature of the body, according to Benedict and Joslin nearly 6 per cent. of the total heat of the day; and it is this excess of sugar in the system that renders the body so favorable a culture medium for pus

Influence of acid-base equilibrium.

Acid tends to increase blood sugar content + sugar elimination.

Alkali in base tends to reduce blood sugar content.

Ordinary diet ∴ tends to aggravate any condition of acidosis

To lay down of acid + bicarb- in an energy of 120 gm. each day.

organisms. There is loss of energy with the steady waste of sugar fuel; practically every gram of sugar excreted in the urine results in a loss of 4.1 calories, consequently a diabetic patient excreting 100 grams of sugar and 20 grams of β-oxybutyric acid loses 500 calories in this way, so that the patients are apt to be underfed, unless this loss is made up by a full amount of other food (Benedict and Joslin). Studies upon the respiratory quotient—which is the ratio between the CO_2 given out and the O taken in by a healthy individual on a mixed diet (expressed by the fraction 0.9)—favor the view that there is failure in the proper combustion of the carbohydrates. Benedict and Joslin conclude that a respiratory quotient above 0.74 indicates a fairly liberal supply of glycogen stored in the body; while a respiratory quotient of 0.70, or below that, indicates that the patient has no available carbohydrates, and has lost in a measure the power of storing them. And here comes the special danger; as the carbohydrates pass through the body unburned, the energy must be provided from the proteins and fats. The metabolism of the former does not appear to be seriously disturbed, and the carbohydrate portion of the protein molecule is well tolerated and in part supplies the place of the lost sugars. The danger is in the metabolism of the fats. The carbohydrates are not used as fuel; the proteins are easily utilized, but apparently it takes so much draught to burn them that not enough is left to consume the fats completely; and the products of incomplete combustion accumulate in the system and suffocate the patient as effectually as does the CO of a charcoal stove. The chief product of this incomplete combustion of the fats is the β-oxybutyric acid, which itself is the source of the diacetic acid and acetone, and the special danger of the disease is now recognized to be the production of an acidosis in consequence of this imperfect fat metabolism.

Morbid Anatomy.—The *nervous system* shows no constant lesions. In a few instances there have been tumors or sclerosis in the medulla, or a cysticercus has pressed on the floor. A secondary multiple neuritis is not rare, and to it the so-called diabetic tabes is probably due, and changes occur in the posterior columns of the cord similar to those which have been found in pernicious anæmia. In the sympathetic system the ganglia have been enlarged and in some instances sclerosed. The *blood* may contain as high as 0.4 per cent. of sugar instead of 0.15 per cent. The plasma is usually loaded with fat, the molecules of which may be seen as fine particles. When drawn, a white creamy layer coats the coagulum, and there may be lipæmic clots in the small vessels. There are no special changes in the red or white corpuscles. The polynuclear leucocytes contain glycogen. Glycogen can occur in normal blood, but it is here extracellular. It has been also found in the polynuclear leucocytes in leukæmia. The *heart* is hypertrophied in some cases. Endocarditis is very rare. Arterio-sclerosis is common. The *lungs* show important changes. Acute broncho-pneumonia or croupous pneumonia (either of which may terminate in gangrene) and tuberculosis are common. The so-called diabetic phthisis is always tuberculous and results from a caseating bronchopneumonia. In rare cases there is a chronic interstitial pneumonia, nontuberculous. Fat embolism of the pulmonary vessels may occur in connection with diabetic coma.

The *liver* is usually enlarged; fatty degeneration is common. In the so-called diabetic cirrhosis—the *cirrhosis pigmentaire*—the liver is enlarged and

sclerotic, and a cachexia develops with melanoderma. Dilatation of the stomach is common.

Pancreas.—Of 15 autopsies in 27 fatal cases, in 9 the pancreas was found atrophic. In one of these fat necroses were present, in another calculi. Hyaline degeneration of the islands of Langerhans has been described by Opie and is a special feature in certain cases. Chronic interstitial pancreatitis is common.

The *kidneys* show a diffuse nephritis with fatty degeneration. Hyaline change is often found in the tubal epithelium, particularly of the descending limb of the loop of Henle, and in the Malphigian tufts.

Symptoms.—*Acute* and *chronic* forms are recognized, but there is no essential difference between them, except that in the former the patients are younger, the course is more rapid, and the emaciation more marked. I have twice seen acute diabetes in the aged.

The *onset* of the disease is gradual, and either frequent micturition or inordinate thirst first attracts attention. Very rarely it sets in rapidly, after a sudden emotion, an injury, or after a severe chill. When fully established the disease is characterized by great thirst, the passage of large quantities of saccharine urine, a voracious appetite, and, as a rule, progressive emaciation.

Among the GENERAL SYMPTOMS of the disease *thirst* is one of the most distressing. Large quantities of water are required to keep the sugar in solution and for its excretion in the urine. The amount of fluid consumed will be found to bear a definite ratio to the quantity excreted. Instances, however, are not uncommon of pronounced diabetes in which the thirst is not excessive; but in such cases the amount of urine passed is never large. The thirst is most intense an hour or two after meals. As a rule, the digestion is good and the appetite inordinate. The condition is sometimes termed *bulimia* or *polyphagia*. Lumbar pain is common.

The tongue is usually dry, red, and glazed, and the saliva scanty. The gums may become swollen, and in the later stages aphthous stomatitis is common. Constipation is the rule.

In spite of the enormous amount of food consumed a patient may become rapidly emaciated. This loss of flesh bears some ratio to the polyuria, and when, under suitable diet, the sugar is reduced, the patient may quickly gain in flesh. The skin is dry and harsh, and sweating rarely occurs, except when phthisis coexists. Drenching sweats have been known to alternate with excessive polyuria. General pruritus or pruritus pudendi may be very distressing, and occasionally is one of the earliest symptoms. The temperature is often subnormal; the pulse is usually frequent, and the tension increased. Many diabetics do not show marked emaciation. Patients past the middle period of life may have the disease for years without much disturbance of the health, and may remain well nourished. These are the cases of the *diabète gras* in contradistinction to *diabète maigre*.

THE URINE.—The amount varies from 3 to 4 litres in mild cases to 15 to 20 litres in very severe cases. In rare instances the quantity of urine is not much increased. Under strict diet the amount is much lessened, and in intercurrent febrile affections it may be reduced to normal. The specific gravity is high, ranging from 1.025 to 1.045; but in exceptional cases it may be low, 1.013 to 1.020. The highest specific gravity recorded, so far as I

CO_2 tension of alveolar air. normal 38–45 mm. Hg.

Slight acidosis	32–38 mm. Hg.	15 mm. lower than
Moderate "	28–32 " "	patient is normal.
Severe "	less than 28 " "	9 mm. lower than

know, is by Trousseau—1.074. Very high specific gravities—1.070 + —suggest fraud. The urine is pale in color, almost like water, and has a sweetish odor and a distinctly sweetish taste. The reaction is acid. Sugar is present in varying amounts. In mild cases it does not exceed 1½ or 2 per cent., but it may reach from 5 to 10 per cent. The total amount excreted in the twenty-four hours may range from 10 to 20 ounces (320 to 640 grams) and in exceptional cases from 1 to 2 pounds. For the ordinary tests the student is referred to the clinical and chemical manuals.

Glycogen has also been found in the urine, and in rare instances sugars other than glucose occur, lactose, levulose, and pentose, and to these conditions the term *melituria* is sometimes applied. *Albumin* is not infrequent.

Pneumaturia, the formation of gas in the urine, due to fermentative processes in the bladder, is occasionally met with.

Cammidge's reaction may be present in the cases with disease of the pancreas. Fat may be passed in the urine in the form of a fine emulsion (lipuria).

Blood in Diabetes.—In true diabetes hyperglycæmia is constant. As coma supervenes, β-oxybutyric acid occurs. Polycythæmia, with the red cells between 6,000,000 and 8,000,000 per c. mm., is not uncommon in the desiccated cases with marked polyuria. Coma is accompanied by a moderate leucocytosis. Lipæmia occurs in a certain number of cases. It is recognized by the presence of innumerable dancing particles between the red cells in a fresh preparation, and by the creamy appearance of the serum of centrifugalized blood. Normal blood contains between 0.16 to 0.325 per cent. of fat. Fraser found 16.44 per cent. of fat in the blood of a diabetic. Opinions vary as to the source of the fat.

Complications.—(*a*) Acidosis.—The chief product of the incomplete combustion of the fats is β-oxybutyric acid, and its derivatives are acetone and diacetic acid. When formed in any large amount these bodies are rapidly excreted in the urine. With their increase there may be a remarkable autointoxication first described by Kussmaul, and known as diabetic coma, which is the most important single cause of death in the disease, occurring in 15 of 27 fatal cases in my series. According to Stephen McKenzie all of the fatal cases of diabetes under 25 at the London Hospital died in coma.

There are three groups of cases:

(1) Typical dyspnœic coma, the air-hunger of Kussmaul, in which there are loud and deep in- and expirations, the pulse grows weak, and the patient gradually fails and dies, sometimes within twenty-four hours. The breath very often has the fruity odor of acetone. It may come on without any premonition and the patient may waken out of sleep in dyspnœa. Dyspepsia, abdominal pains, restlessness and irritability may precede the attack. (2) Cases in which, without any previous dyspnœa or distress, the patient is attacked with headache, a feeling of intoxication, thick speech and a staggering gait, and gradually falls into deep coma. (3) Cases in which, particularly after exertion, the patient is attacked suddenly with weakness, giddiness and fainting; the hands and feet are cold and livid, the pulse small, respiration rapid; the patient becomes drowsy, and death occurs within a few hours.

(*b*) Cutaneous.—Boils and carbuncles are extremely common. Painful onychia may occur. Eczema is also met with, and at times an intolerable

itching. In women the irritation of the urine may cause the most intense pruritus pudendi, and in men a balanitis. Rarer affections are xanthoma and purpura. Gangrene is not uncommon, and is associated usually with arterio-sclerosis. Perforating ulcer of the foot occurred in 7 of 276 cases. Bronzing of the skin (*diabète bronzé*) occurs in certain cases in which the diabetes arises as a late event in the disease known as hæmochromatosis, which is further characterized by pigmentary cirrhosis of the liver and pancreas. With the onset of severe complications the tolerance of the carbohydrates is much increased. Profuse sweats may occur.

(*c*) PULMONARY.—The patients are not infrequently carried off by *acute pneumonia*, which may be lobar or lobular. *Gangrene* is very apt to supervene, but the breath does not necessarily have the foul odor of ordinary gangrene. Abscess following lobar pneumonia occurred in one of my cases. *Tuberculous broncho-pneumonia* is very common and may run a very rapid course.

(*d*) RENAL.—*Albuminuria* is a tolerably frequent complication. The amount varies greatly, and, when slight, does not seem to be of much moment. Œdema of the feet and ankles is not an infrequent symptom. General anasarca is rare, however, owing to the marked polyuria. It is sometimes associated with arterio-sclerosis. It occasionally precedes the occurrence of the diabetic coma. Occasionally cystitis is a troublesome symptom.

(*e*) NERVOUS SYSTEM.—*Peripheral Neuritis.*—Neuralgia, numbness and tingling, uncommon symptoms in diabetes, are probably minor neuritic manifestations. The involvement may be general of the upper and lower extremities. Sometimes it is unilateral, or the neuritis may be in a single nerve—the sciatic or the third nerve. Herpes zoster may occur.

Diabetic Tabes (so-called).—This is a peripheral neuritis, characterized by lightning pains in the legs, loss of knee-jerk—which may occur without the other symptoms—and a loss of power in the extensors of the feet. The gait is the characteristic *steppage*, as in arsenical, alcoholic, and other forms of neuritic paralysis. Charcot states that there may be atrophy of the optic nerves. Changes in the posterior columns of the cord have been found by Williamson and others.

Diabetic Paraplegia.—This is also in all probability due to neuritis. There are cases in which power has been lost in both arms and legs.

Mental Symptoms.—The patients are often morose, and there is a strong tendency to become hypochondriacal. General paralysis has been met with. Some patients display an extraordinary degree of restlessness and anxiety.

(*f*) SPECIAL SENSES.—Cataract is liable to occur, and with rapidity in young persons. Diabetic retinitis closely resembles the albuminuric form. Hæmorrhages are common. Sudden amaurosis, similar to that which occurs in uræmia, may occur. Paralysis of the muscles of accommodation may be present; and, lastly, atrophy of the optic nerves. Aural symptoms may come on with great rapidity, either an otitis media, or in some instances inflammation of the mastoid cells.

(*g*) SEXUAL FUNCTION.—Impotence is common, and may be an early symptom. Conception is rare; if it occurs, abortion is apt to follow. A diabetic mother may bear a healthy child; there is no known instance of a dia-

betic mother bearing a diabetic child. The course of the disease is usually aggravated after delivery.

Diagnosis.—There is no difficulty in determining the presence of sugar in the urine if the proper tests are applied. Alcapton may prove very deceptive, and in one case of ochronosis which I reported a diagnosis of diabetes was made by four or five of the leading physicians in Europe, one of whom was an authority on diabetes. Deception may be practiced. A young girl under my care had urine with a specific gravity of 1.065, but the reactions were for cane sugar; and there is a case in the literature in which, when the cane sugar fraud was detected, the woman bought grape sugar and put it into her bladder.

To determine whether the case is one of simple glycosuria or of true diabetes is not always easy, as the one readily merges into the other. The younger the individual the greater the probability that the case is one of true diabetes. It is well always to test the assimilation limit; 100 grams of glucose given in solution two hours after a breakfast of a roll and butter with coffee should not give glycosuria. To do so indicates a deficiency in the capacity to store carbohydrates and a possibility that true diabetes may follow. Transient glycosuria occurs in a great many conditions already mentioned. For practical purposes the common form is that met with in persons above 50 years of age, who eat and drink too much and tend to grow stout. The detection of a little sugar in the urine may have the great advantage of frightening the patient into a more rational mode of life. The forms following anæsthesia, accidents, business worries, fright and that which occurs in pregnancy are, as a rule, readily controlled.

Prognosis.—The younger the patient the less likely is recovery. In children the disease may run a very rapid course, and death may occur within a few weeks, or, indeed, a child may die in coma before the condition has been recognized. The case referred to by Morton, in which one recovered of four children in a family affected, is one of the few instances on record. Personally I have not known an instance of recovery in a child. On the other hand, in persons over fifty sugar may be present in the urine for years without any impairment of strength or health. The outlook is good in the fat, bad in the lean. It is particularly good in the stout, active, business man, whose glycosuria has come on as a result of worry, work, and excess in food and drink.

The following steps should be taken to estimate the gravity of a case. First, the output of sugar should be estimated on three successive days on a carbohydrate-free diet. Secondly, if the sugar disappears, gradually test the assimilating capacity of the body with various carbohydrates. In most cases of glycosuria and mild diabetes the sugar completely disappears on a carbohydrate-free diet, and a certain quantity of carbohydrate can be dealt with without causing hyperglycæmia. Thirdly, test for the presence of acetone and diacetic acid, as they usually indicate a serious disturbance in the metabolism of the fats. It is well to remember, however, that the acetone bodies may be only temporarily present, and it is not necessary to sign the patient's death warrant so soon as they appear. A patient may live for many years with traces, and they may disappear after having been present for months.

Treatment.—In families with a marked predisposition to the disease the use of starchy and saccharine articles of diet should be restricted.

The personal hygiene of a diabetic patient is of the first importance. Sources of worry should be avoided, and he should lead an even, quiet life, if possible in an equable climate. The heat waste should be prevented by wearing warm clothes and avoiding cold. A warm, or, if tolerably robust, a cold, bath should be taken every day. An occasional Turkish bath is useful. Systematic, moderate exercise should be taken. When this is not feasible, massage should be given. It is well to study accurately the dietetic capabilities of each patient, for no two can be treated alike. The weight should be recorded weekly. A patient who is glycosuric and losing weight on a non-carbohydrate diet must be regarded as doing badly. By the addition of a certain amount of starchy food the same person may excrete a moderate amount of sugar and hold or even gain in weight.

DIET.—Keep the patient for three or four days on an ordinary diet, which contains moderate amounts of carbohydrates, in order to ascertain the amount of sugar excretion. For two days more the starches are gradually cut off. He is then placed on the following non-carbohydrate diet, modified in each case according to the patient's age and weight, and arranged from a list recommended by von Noorden:

Breakfast: 7:30, 200 c. c. (℥ vi) of tea or coffee: 150 grams (℥ iv) of beefsteak, mutton-chops without bone, or boiled ham; one or two eggs.

Lunch: 12:30, 200 grams (℥ vi) cold roast beef; 60 grams (℥ ij) celery, fresh cucumbers or tomatoes with vinegar, olive oil, pepper and salt to taste; 20 c. c. (℥ v) whisky with 400 c. c. (℥ xiij) water; 60 c. c. (℥ ij) coffee, without milk or sugar.

Dinner: 6 P. M., 200 c. c. clear bouillon; 250 grams (℥ viiss) roast beef; 10 grams (℥ iiss) butter; 80 grams (℥ ij) green salad, with 10 grams (℥ iiss) vinegar and 20 grams (℥ v) olive oil, or three tablespoonfuls of some well-cooked green vegetable, three sardines à l'huile; 20 c. c. (℥ v) whisky, with 400 c. c. (℥ xiij) water.

Supper: 9 P. M., two eggs (raw or cooked); 400 c. c. (℥ xiij) water.

This diet contains about 200 grams of albumin and about 135 grams of fat. The effect of the diet on the sugar excretion is remarkable. In many cases there is an entire disappearance of the sugar from the urine in three or four days. Chart XV shows very graphically the remarkable drop in the sugar excretion for the first twenty-four hours. In cases in which the urine becomes free from sugar gradually increasing quantities of starch up to 20, 50, and 100 grams are added daily. White bread contains fifty-five per cent. of starch. The effect of the non-carbohydrate diet is to improve the metabolic functions so that the system can warehouse considerable quantities of carbohydrates without sugar appearing in the urine. In patients on a strict diet who continue to excrete from 0.1 to 0.5 per cent. of glucose a "hunger-day" may be given, during which all food is cut off for twenty-four hours. Aglycosuria may occur, and the patient's power of assimilating carbohydrates is increased; but this should not be tried if much diacetic acid is present.

In cases in which a standard diet is not ordered it is well to begin cutting off article by article until the sugar disappears from the urine. Within a month or two the patient may be allowed a more liberal diet, testing the different kinds of food.

The *oatmeal diet,* introduced by von Noorden, is most excellent, particu-

larly in the severer forms. Two hundred and fifty grams of oatmeal, the same amount of butter and the whites of six or eight eggs constitute the day's food. The oatmeal is cooked for two hours, and the butter and albumin stirred in. It may be taken in four portions during the day. Coffee, tea, or whisky and water may be taken with it.

When diacetic acid is present and if the weight is falling the carbohydrates should not be too much restricted. Much acid means that glycogen storage is

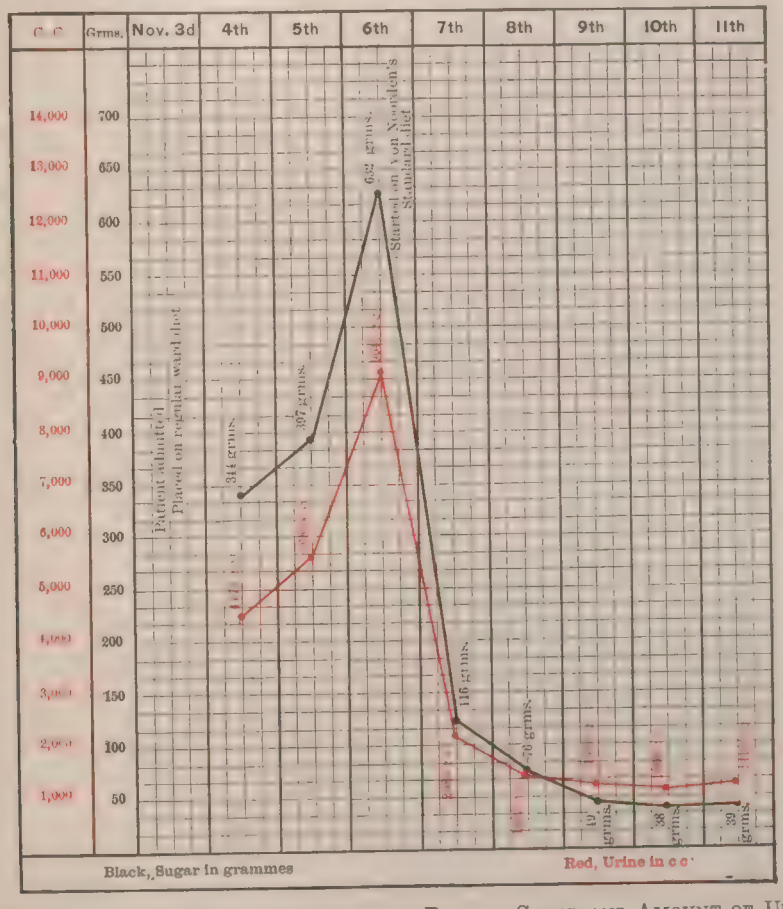

CHART XV.—ILLUSTRATING INFLUENCE OF DIET ON SUGAR AND AMOUNT OF URINE.

low and the body has had to resort to fats, which are with difficulty and imperfectly burnt. The more easily assimilated oatmeal and potato may be used freely and alkalies given to neutralize the excess of acids.

The following is a list of articles which diabetic patients may take:

Liquids: Soups—ox-tail, turtle, bouillon, and other clear soups. Lemonade, coffee, tea, chocolate, and cocoa; these to be taken without sugar, but they may be sweetened with saccharin. Potash or soda water, and Apollinaris, or the Saratoga-Vichy, and milk in moderation may be used.

Of animal food: Fish of all sorts, including crabs, lobsters, and oysters;

salt and fresh butcher's meat (with the exception of liver), poultry, and game. Eggs, butter, buttermilk, curds, and cream cheese.

Of bread: Gluten and bran bread, and almond and cocoanut biscuits. Aleuronat and roborat flours are made from wheat and contain large quantities of albumin and but little starch. They may be used in making bread or biscuits, and are highly recommended by Ebstein.

Of vegetables: Lettuce, tomatoes, spinach, chicory, sorrel, radishes, asparagus, water-cress, cucumbers, celery, endives, mustard, and various pickles.

Fruits: Lemons and oranges. Currants, plums, cherries, pears, apples (tart), melons, raspberries, and strawberries may be taken in moderation. Nuts are, as a rule, allowable.

Among *prohibited articles* are the following: Thick soups and liver.

Ordinary bread of all sorts (in quantity), rye, wheaten, brown, or white. All farinaceous preparations, such as hominy, rice, tapioca, semolina, arrowroot, sago, and vermicelli.

Of vegetables: Potatoes, turnips, parsnips, squashes, vegetable-marrows of all kinds, beets, corn, artichokes.

Of liquids: Beer, sparkling wine of all sorts, and the sweet aërated drinks.

In feeding a diabetic patient one of the greatest difficulties is in arranging a substitute for bread. Of the gluten foods many are very unpalatable; others are frauds.

Other substitutes are the almond food, the Aleuronat bread, and soya bread, but these and other substitutes are not satisfactory, as a rule. For sweetening purposes saccharin may be used, of which tablets are prepared. Mossé has shown that potato starch is more easily assimilated than wheat starch, and this view has been on the whole confirmed by comparative tests in my wards. He allows as much as a kilo (2⅕ pounds) of potatoes, weighed fresh, to a diabetic daily. They are best baked.

Medicinal Treatment.—This is most unsatisfactory, and no one drug appears to have a directly curative influence. Opium alone stands the test of experience as a remedy capable of limiting the progress of the disease. Diabetic patients seem to have a special tolerance for this drug. Codeia was preferred by Pavy, and has the advantage of being less constipating than morphia. A patient may begin with half a grain three times a day, which may be gradually increased to 6 or 8 grains in the twenty-four hours. Not much effect is noticed unless the patient is on a rigid diet. When the sugar is reduced to a minimum, or is absent, the opium should be gradually withdrawn. The patients not only bear well these large doses of the drug, but they stand its gradual reduction. Potassium bromide is often a useful adjunct. The arsenite of bromine, a solution of arsenious acid with bromine in glycerin (dose, 3 to 5 minims after meals), has been very highly recommended, but it is by no means so certain as opium. Arsenic alone may be used. Antipyrin may be given in doses of 10 grains three times a day, and in cases with a marked neurotic constitution is sometimes satisfactory. The salicylates, iodoform, nitroglycerin, jambul, the lithium salts, strychnine, creosote, and lactic acid have been employed.

Preparations of the pancreas (glycerin extracts of the dried and fresh gland) have been used in the hope that they would supply the internal secretion necessary to normal sugar metabolism. The success has not, however,

been in any way comparable with that obtained with the thyroid extract in myxœdema. Lépine has isolated a glycolytic ferment from the pancreas and also from the malt diastase, and has used it with some success in 4 cases.

Of the complications, the *pruritus* and *eczema* are best treated by cooling lotions of boric acid or hyposulphite of soda (1 ounce; water, 1 quart), or the use of ichthyol and lanolin ointment.

In the thin, nervous patients the bowels should be kept open and the urine tested at short intervals for acetone and diacetic acid—the derivatives of β-oxybutyric acid.

The *coma* is an almost hopeless complication. Inhalations of oxygen have been recommended. The use of bicarbonate of soda in very large doses is recommended to neutralize the acid intoxication. It may be used intravenously; as much as 80 grams have been injected. The solution used for intravenous injection is a 1 to 2 per cent. solution of sodium bicarbonate in normal salt solution, made from freshly distilled water. A litre may be injected slowly into a vein every six hours in desperate cases. In the less serious cases administration should be made by mouth, or mouth and rectum. This treatment, first recommended by Stadelmann, has undoubtedly given the best results. I have had one recovery. The sodium bicarbonate should be pushed until the urine is alkaline, and as much as 100 grams given daily. All diabetics with a marked diacetic acid reaction in the urine should be placed on sodium bicarbonate. Next to the antacid treatment, subcutaneous or intravenous injections of normal salt solution have given the best results. The improvement, unfortunately, is only temporary with this line of treatment. Reynolds published 2 cases of recovery after the administration of a dose of castor oil, followed by 30 to 60 grains of citrate of potassium every hour in copious draughts of water. The bowels of a diabetic patient should be kept acting freely, as constipation is believed to predispose to the development of coma.

III. DIABETES INSIPIDUS

Definition.—A chronic affection characterized by the passage of large quantities of normal urine of low specific gravity.

The condition is to be distinguished from diuresis or polyuria, which is a frequent symptom in hysteria, in ~~Bright's disease~~ nephritis, and occasionally in cerebral or other affections. Willis in 1674 first recognized the distinction between a saccharine and non-saccharine form of diabetes.

Etiology.—The disease is most common in young persons. Of the 85 cases collected by Strauss, 9 were under five years; 12 between five and ten years; 36 between ten and twenty-five years. Males are more frequently attacked than females. The affection may be congenital. A hereditary tendency has been noted in many instances, the most extraordinary of which has been reported by Weil. Of 91 members in four generations, 23 had persistent polyuria without any deterioration in health.

Clinical Classification.—There are two forms: primary or idiopathic, in which there is no evident organic basis, and secondary or symptomatic, in which there is evidence of disease in the brain or elsewhere. Of 9 cases reported from my clinic by Futcher, 4 belonged to the former and 5 to the

latter group. Trousseau stated that the parents of children with diabetes insipidus frequently have glycosuria or albuminuria. The disease has followed rapidly the copious drinking of cold water, or a drinking bout, or has set in during the convalescence from an acute disease.

The secondary or symptomatic form is almost always associated with injury or disease of the nervous system, traumatism to the head or, in some cases, to the trunk. It occurs in 30 per cent. of the cases, according to Stoermer. Tumors of the brain, lesions of the medulla, cerebral hæmorrhage have been met with in some cases. There is a remarkable association between diabetes insipidus and brain syphilis; 5 of the 9 cases reported by Futcher were in syphilitics. The lesion is usually at the base, and meningitic. Hemianopsia is present in a number of these cases; it occurred in 2 of Futcher's series. It is not necessary that the lesions should involve the medulla. It has been met with in spinal cord lesions. In tumors and aneurisms in the abdomen, in tuberculous peritonitis, and in carcinoma there may be polyuria of an extreme grade.

The most reasonable view of the production of the polyuria is that it results from a vasomotor disturbance of the renal vessels, due either to local irritation, as in a case of abdominal tumor, to central disturbance in cases of brain-lesion, or to functional irritation of the centre in the medulla, giving rise to continuous renal congestion. In some cases the functional capacity of the kidney to eliminate salt and urea is diminished.

Morbid Anatomy.—There are no constant anatomical lesions. The *kidneys* have been found enlarged and congested. The *bladder* has been found hypertrophied. Dilatation of the ureters and of the pelves of the kidneys has been present. Death has not infrequently resulted from chronic pulmonary disease. Very varied lesions have been met with in the nervous system.

Symptoms.—The disease may come on rapidly, as after a fright or an injury; more commonly it is gradual. A copious secretion of urine, with increased thirst, is the prominent feature of the disease. The amount of urine in the twenty-four hours may range from 20 to 40 pints, or even more. Trousseau speaks of a patient who consumed 50 pints of fluid daily and passed about 56 pints of urine in the twenty-four hours. In two of our cases the amount passed was greater than that ingested in liquids and solids. The specific gravity is low, 1.001 to 1.005; the color is extremely pale and watery. The total solid constituents may not be reduced. The amount of urea has sometimes been found in excess. Abnormal ingredients are rare. Muscle-sugar, inosite, has been occasionally found. Albumin is rare. Traces of sugar have been met with. Naturally, with the passage of such enormous quantities of urine, there is a proportionate thirst, and the only inconvenience of the disease is the necessity for frequent micturition and frequent drinking. The appetite is usually good, rarely excessive as in diabetes mellitus; but Trousseau tells of the terror inspired by one of his patients in the keepers of those eating-houses where bread was allowed without extra charge to the extent of each customer's wishes, and says that the man was paid to stay away. The patients may be well nourished and healthy-looking. The disease in many instances does not appear to interfere in any way with the general health. The perspiration is naturally slight and the skin is harsh. The amount of saliva is small and the mouth usually dry. The tolerance of al-

Freud's post. Lobe of Hirnrinde. Lesions do not the aud.
Lobe but no effects — one half by [illegible] ad. of Cc.
others say unimportant if given Impls

cohol is remarkable, and patients have been known to take a couple of pints of brandy, or a dozen or more bottles of wine, in the day.

Course.—The course depends entirely upon the nature of the primary trouble. Sometimes, with organic disease, either cerebral or abdominal, the general health is much impaired; the patient becomes thin, and rapidly loses strength. In the essential or idiopathic cases good health may be maintained for an indefinite period, and the affection has been known to persist for fifty years. Death usually results from some intercurrent affection. Spontaneous cure may take place.

Diagnosis.—A low specific gravity and the absence of sugar in the urine distinguish the disease from diabetes mellitus. Hysterical polyuria may sometimes simulate it very closely. The amount of urine excreted may be enormous, and only the development of other hysterical manifestations may enable the diagnosis to be made. This condition is, however, always transitory.

In certain cases of chronic Bright's disease a very large amount of urine of low specific gravity may be passed, but the presence of albumin and of hyaline casts and the existence of heightened arterial tension, stiff vessels, and hypertrophied left ventricle make the diagnosis easy.

Treatment.—The treatment is not satisfactory. No attempt should be made to reduce the amount of liquid. In some cases gradual reduction of the protein and salt intake is useful. This should be done gradually. Opium is highly recommended, but is of doubtful service. The preparations of valerian may be tried; either the powdered root, beginning with 5 grains (0.3 gm.) three times a day, and increasing until 2 drachms (8 gm.) are taken in the day, or the valerianate of zinc, in 15-grain (1 gm.) doses, gradually increased to 30 grains (2 gm.), three times a day. Theocin is sometimes useful in doses of 5 grains (0.3 gm.) three times a day. Antisyphilitic treatment should be thoroughly tried in patients with a suspicious history or a positive Wassermann reaction. Electricity may be used.

IV. RICKETS (RHACHITIS)

Definition.—A disease of infants, characterized by impaired nutrition of the entire body and alterations in the growing bones.

Glisson, the anatomist of the liver, accurately described the disease in 1650. The name is derived from the old English word *wrickken*, to twist. Glisson suggested to change the name to rhachitis, from the Greek, ῥάχις, the spine, as it was one of the first parts affected, and also from the similarity in the sound to rickets.

Etiology.—Rickets exists in all parts of the world, but is particularly marked among the poor of the larger cities, who are badly housed and ill fed. It is much more common in Europe than in America. In Vienna and London from 50 to 80 per cent. of all the children at the clinics present signs of rickets. It is a comparatively rare disease in Canada. In the cities of the United States it is very prevalent, particularly among the children of the negro and of the Italian races. Want of sunlight, impure air, confinement, and lack of exercise are important factors. Prolonged lactation and suckling the child during pregnancy are accessory influences in some cases.

There is no evidence that the disease is hereditary.

Rickets affects male and female children equally. It is a disease of the first and second years of life, rarely beginning before the sixth month. Jenner has described a late rickets, in which form the disease may not appear until the ninth or even until the twelfth year, or later (the osteomalacia of puberty). A faulty diet is a factor in the production of the disease. Like scurvy, rickets may be found in the families of the wealthy under perfect hygienic conditions. It is most common in children fed on condensed milk, the various proprietary foods, cow's milk, and food rich in starches. "An analysis of the foods on which rickets is most frequently and certainly produced shows invariably a deficiency in two of the chief elements so plentiful in the standard food of young animals—namely, animal fat and proteid" (Cheadle). Bland Sutton's interesting experiment with the lion's cubs at the "Zoo" illustrates this point. When milk, pounded bones, and cod-liver oil were added to the meat diet the rickets disappeared, and for the first time in the history of the society the cubs were reared. Associated with the defect in food is a lack of proper assimilation of the lime salts.

Morbid Anatomy.—Glisson's original description of the external appearances of the body of a rickety child is remarkably complete; indeed, the entire monograph is an enduring monument to the skill and powers of observation of this great physician. "(1) An irregular or unusual proportion of its parts. The head is evidently larger than normal, and the face fatter in respect to the other parts. . . . (2) The external members and muscles of the whole body are seen to be delicate and emaciated, as though consumed by atrophy or tabes, and this (so far as we know) is always observed in those dead of this affection. (3) The whole skin, both the true and the fleshy and fatty layers, is flaccid and rather pendulous, like a loose glove, so that you think it could hold much more flesh. (4) About the joints, especially in the wrists and ankles, there are certain protuberances which, if opened, are seen to arise, not in the fleshy or membranous parts, but in the ends of the bones themselves, especially in their epiphyses. (5) The joints, limbs, and habitus of all these external parts are less firm and rigid, less inflexible than in other dead bodies, and the neck scarcely becomes rigid, *a frigore,* post mortem, or to a less extent than in other cadavers. (6) The chest externally is thin and much narrowed, especially beneath the scapulæ, as though compressed from the sides, and the sternum accuminated like the keel of a ship or the breast of a fowl. (7) The ends of the ribs which join with the cartilages of the sternum are nodular, like the ends of the wrists and ankles."

He also describes the prominent abdomen, the enlarged liver, and the changes in the mesenteric glands.

The bones show the most important changes, particularly the ends of the long bones and the ribs. Between the shaft and epiphyses a slight bulging is apparent, and on section the zone of proliferation, which normally is represented by two narrow bands, is greatly thickened, bluish in color, more irregular in outline, and very much softer. The width of this cushion of cartilage varies from 5 to 15 mm. The line of ossification is also irregular and more spongy and vascular than normal. The periosteum strips off very readily from the shaft, and beneath it there may be a spongy tissue not unlike decalcified bone. The practical outcome of these changes is an imperfect

ossification, so that the bone has neither the natural rate of growth nor the normal firmness. In the cranium there may be large areas, particularly in the parieto-occipital region, in which the ossification is delayed, producing the so-called cranio-tabes, so that the bone yields readily to pressure with the finger. There are localized depressed spots of atrophy, which, on pressure, give the so-called "parchment crackling." Flat hyperostoses arise on the outer table, particularly on the frontal and parietal bones, producing the characteristic broad forehead with prominent frontal eminences, a condition sometimes mistaken for hydrocephalus.

Kassowitz, the leading authority on the anatomy of rickets, regards the hyperæmia of the periosteum, the marrow, the cartilage, and of the bone itself as the primary lesion, out of which all the others arise. It is interesting to note that Glisson attributed rickets to disturbed nutrition by arterial blood, and believed the changes in the long bones to be due to excessive vascularity.

The chemical analysis of rickety bones shows a marked diminution in the calcareous salts, which may be as low as 25 or 35 per cent.

The liver and spleen are usually enlarged, and sometimes the mesenteric glands. As Gee suggested, these conditions probably result from the general state of the health associated with rickets. Beneke has described a relative increase in the size of the arteries in rickets.

Symptoms.—The disease comes on insidiously about the period of dentition, before the child begins to walk. Mild grades of it are often overlooked. In many cases digestive disturbances precede the appearance of the characteristic lesions, and the nutrition of the child is markedly impaired. There is usually slight fever, the child is irritable and restless, and sleeps badly. If he has already walked, he now shows a marked disinclination to do so, and seems feeble and unsteady in his gait. Sir William Jenner called attention to three general symptoms of great importance: First, a diffuse soreness of the body, so that the child cries when an attempt is made to move it, and prefers to keep perfectly still. Secondly, slight fever (100° to 101.5° F.), with nocturnal restlessness, and a tendency to throw off the bedclothes. This may be partly due to the fact that the general sensitiveness is such that even their weight may be distressing. And thirdly, profuse sweating, particularly about the head and neck, so that in the morning the pillow is soaked with perspiration.

The tissues become soft and flabby; the skin is pale; and from a healthy, plump condition the child becomes puny and feeble. The muscular weakness may be marked, particularly in the legs, and paralysis may be suspected. This so-called pseudo-paresis of rickets results in part from the flabby, weak condition of the legs and in part from the pain associated with the movements. Coincident with, or following closely upon, the general symptoms the characteristic skeletal lesions are observed. Among the first of these to appear are the changes in the ribs, at the junction of the bone with the cartilage, forming the so-called rickety rosary. When the child is thin these nodules may be distinctly seen, and in any case can be easily made out by touch. They very rarely appear before the third month. They may increase in size up to the second year, and are rarely seen after the fifth year. The thorax undergoes important changes. Just outside the junction of the cartilages with the ribs there is an oblique, shallow depression extending downward and outward.

A transverse curve, sometimes called Harrison's groove, passes outward from the level of the ensiform cartilage toward the axilla, and may be deepened at each inspiration. It is rendered more prominent by the eversion and prominence of the costal border. The sternum projects, particularly in its lower half, forming the so-called pigeon or chicken breast. These changes in the thorax are not peculiar, however, to rickets, and are much more commonly associated with hypertrophy of the tonsils, or any trouble which interferes with the free entrance of air into the lungs. The spine is often curved posteriorly, the processes are prominent; lateral curvature is not so common.

The head of a rickety child usually looks large in proportion both to the body and the face, and the fontanelles remain open for a long time. There are areas, particularly in the parieto-occipital regions, in which ossification is imperfect; and the bone may yield to the pressure of the finger, a condition to which the term *cranio-tabes* has been given. Coincidently with this, hyperplasia proceeds in the frontal and parietal eminences, so that these portions of the skull increase in thickness, and may form irregular bosses. In one type the skull may be large and elongated, with the top considerably flattened. In another, and perhaps more common, case the shape of the skull, when seen from above, is rectangular—the *caput quadratum*. The skull looks large in proportion to the face. The forehead is broad and square, and the frontal eminences marked. The anterior fontanelle is late in closing, and may remain open until the third or fourth year. The skin is thin, the veins are full and prominent, and the hair is often rubbed from the back of the skull.

On placing the ear over the anterior fontanelle, or in the temporal region, a systolic murmur may frequently be heard. This condition, first described by John D. Fisher, of Boston, in 1833, is heard with the greatest frequency in rickets, but its presence and persistence in perfectly healthy infants have been amply demonstrated. The murmur is rarely present after the fifth year. A knowledge of the existence of this systolic brain murmur may prevent errors. A case has been reported as an instance of tumor of the brain.

Changes occur in the bones of the face, chiefly in the maxillæ, which are reduced in size. The normal process of dentition is much disturbed; indeed, late teething is one of the marked features in rickets. The teeth which appear may be small and badly formed.

In the upper limbs changes in the scapulæ are not common. The clavicle may be thickened at the sternal end, and there may be thickening near the attachment of the sterno-cleido muscle. The most noticeable changes are at the lower ends of the radius and ulna. The enlargement is at the junction-area of the shaft and epiphysis. Less evident enlargements may occur at the lower end of the humerus. In severe cases the natural shape of the bones of the arm may be much altered, since they have had to support the weight of the child in crawling on the floor. The changes in the pelvis are of special importance, particularly in female children, as in extreme cases they lead to great deformity, with narrowing. In the legs, the lower end of the tibia first becomes enlarged; and in slight cases it may alone be affected. In the severe forms the upper end of the bone, the corresponding parts of the fibula, and the lower end of the femur become greatly thickened. If the child walks, slight bowing of the tibiæ inevitably results. In more advanced cases the tibiæ, and even the femora, may be arched forward. In other instances the

condition of knock-knee occurs. Unquestionably the chief cause of these deformities is the weight of the body in walking, but muscular action takes part in it. The green-stick fracture is not uncommon in the soft bones of rickets.

These changes in the skeleton proceed slowly, and the general symptoms vary a good deal with their progress. The child becomes more or less emaciated, though "fat rickets" is by no means uncommon, and a child may be well nourished but "pasty" and flabby. Fever is not constant, but in actively progressing changes in the bone there is usually a slight pyrexia. The abdomen is large, "pot-bellied," due partly to flatulent distention, partly to enlargement of the liver, and in severe cases to diminution of the volume of the thorax. The spleen is often enlarged and readily palpable. The urine is stated to contain an excess of lime salts. There is usually slight anæmia, the hæmoglobin is absolutely and relatively decreased; a leucocytosis may or may not be present; it is more common with enlargement of the spleen (Morse). Many rickety children show marked nervous symptoms; irritability, peevishness, and sleeplessness are constantly present. Jenner called attention to the close relationship which existed between rickets and infantile convulsions, particularly to the fits which occur after the sixth month. Tetany is by no means uncommon. It involves most frequently the arms and hands; occasionally the legs as well. Laryngismus stridulus is a common complication, and though not, as some state, invariably associated, yet it is certainly much more frequent in rickety than in other children. Severe rickets interferes seriously with the growth of a child. Extreme examples of rickety dwarfs are not uncommon. Acute rickets, so-called, is in reality a manifestation of scurvy and will be described with that disease.

Prognosis.—The disease is never in itself fatal, but the condition of the child is such that it is readily carried off by intercurrent affections, particularly those of the respiratory organs. Spasm of the larynx and convulsions occasionally cause death. In females the deformity of the pelvis is serious, as it may lead to difficulties in parturition.

Treatment.—The better the condition of the mother during pregnancy the less likelihood is there of the development of rickets in the child. Rapidly repeated pregnancies and suckling of a child during pregnancy seem important factors in the production of the disease. Of the general treatment, attention to the feeding of the child is the first consideration. If the mother is unhealthy, or cannot from any cause nurse the child, a suitable wet-nurse should be provided, or the child must be artificially fed, in which case cow's milk, diluted according to the age of the child, should constitute the chief food. Care should be taken to examine the condition of the stools, and if curds are present the child is taking too much, or it is not sufficiently diluted. Barley-water and carefully strained and well-boiled oatmeal gruel form excellent additions to the milk.

The child should be warmly clad and should be in the fresh air and sunshine the greater part of the day. The child should be bathed daily in warm water. Careful friction with sweet oil is very advantageous, and, if properly performed, allays rather than aggravates the sensitiveness. Special care should be taken to prevent deformity. The child should not be allowed to walk, and for this purpose splints applied so as to extend beyond the feet are very ef-

fective. Of medicines, phosphorus has been warmly recommended by Kassowitz, and its use is also advised by Jacobi. The child may be given gr. 1/120 two or three times a day, dissolved in olive oil. The best preparation in such cases is the elixir phosphori, six to ten or twelve minims three times a day (Jacobi). Cod-liver oil, in doses of from a half to one teaspoonful, is very advantageous. The syrup of the iodide of iron may be given with the oil. The digestive disturbances, together with the respiratory and nervous complications, should receive appropriate treatment.

V. SCURVY

(*Scorbutus*)

Definition.—A disorder of metabolism of unknown origin, characterized by great debility, with anæmia, a spongy condition of the gums, and a tendency to hæmorrhages.

Etiology.—The disease has been known from the earliest times, and has prevailed particularly in armies in the field and among sailors on long voyages. It has been well called "the calamity of sailors."

From the early part of the last century, owing largely to the efforts of Lind and to a knowledge of the conditions upon which the disease depends, scurvy has gradually disappeared from the naval service. In the mercantile marine cases still occasionally occur, owing to the lack of proper and suitable food.

In parts of Russia scurvy is endemic. In the United States scurvy is not a very rare disease. To the hospitals in the seaport towns sailors are now and then admitted with it. In large almshouses outbreaks occasionally occur. A very great increase of foreign population of a low grade has in certain districts made the disease not at all uncommon. In the mining districts of Pennsylvania the Hungarian, Bohemian, and Italian settlers are not infrequently attacked. McGrew has reported 42 cases in Chicago, limited entirely to Poles. He ascertained that in a large proportion of the cases the diet was composed of bread, strong coffee, and meat. Occasionally one meets with scurvy among quite well-to-do people. Some years ago scurvy was not infrequent in the large lumbering camps in the Ottawa Valley. In Great Britain and Ireland it has become very rare; only 302 cases were admitted to the Seaman's Hospital in the twenty-two years ending 1896 (Johnson Smith). It is not uncommon in the South African natives.

The cause is unknown; there are three theories of the disease:

(*a*) That it is the result of an absence of those ingredients in the food which are supplied by fresh vegetables. What these constituents are has not yet been definitely determined, whether the potassium salts or the absence of the organic salts present in fruits and vegetables. Wright has brought forward evidence which suggests that it may be an acid intoxication. That it is not due to an absence of fresh vegetables or the salts of fruits and vegetables seems to have been settled by Nansen and his comrades, who, living for months under the most unfavorable hygienic surroundings, but eating fresh bear's meat and bear's blood, escaped scurvy.

Magnesium a distinct Lacking in physical rather than chemical
qualities.

(*b*) That it is due to toxic materials in the food—some unknown organic poison the product of decomposition. Holst and Frölich oppose this toxic view, and maintain that the disease is due to the lack in the food of nutrient constituents which so far have not been identified.

(*c*) In opposition to these chemical views it is urged that the disease depends upon a specific (as yet unknown) micro-organism.

Other factors play an important part, particularly physical and moral influences—overcrowding, dwelling in cold, damp quarters, and prolonged fatigue under depressing influences, as during the retreat of an army. Among prisoners, mental depression plays an important rôle. It is stated that epidemics of the disease have broken out in the French convict ships *en route* to New Caledonia even when the diet was amply sufficient. Nostalgia is sometimes an important element. It is an interesting fact that prolonged starvation in itself does not necessarily cause scurvy. Not one of the professional fasters of late years has displayed any scorbutic symptom. The disease attacks all ages, but the old are more susceptible to it. Sex has no special influence, but during the siege of Paris it was noted that the males attacked were greatly in excess of the females.

Morbid Anatomy.—The anatomical changes are marked, though by no means specific, and are chiefly those associated with hæmorrhage. The blood is dark and fluid. The microscopic alterations are those of a severe anæmia, without leucocytosis. The skin shows the ecchymoses evident during life. There are hæmorrhages into the muscles, and occasionally about or even into the joints. Hæmorrhages occur in the internal organs, particularly on the serous membranes and in the kidneys and bladder. The gums are swollen and sometimes ulcerated, ~~so that in advanced cases the teeth are loose and have even fallen out.~~ Ulcers are occasionally met with in the ileum and colon. Hæmorrhages into the mucous membranes are extremely common. The spleen is enlarged and soft. Parenchymatous changes are constant in the liver, kidneys, and heart.

Symptoms.—The disease is insidious in its onset. Early symptoms are loss in weight, progressive weakness, and pallor. Very soon the gums are noticed to be swollen and spongy, to bleed easily, and in extreme cases to present a fungous appearance. These changes, regarded as characteristic, are sometimes absent. The teeth may become loose and even fall out. Actual necrosis of the jaw is not common. The breath is excessively foul. The tongue is swollen, but may be red and not much furred. The salivary glands are occasionally enlarged. Hæmorrhages beneath the mucous membranes of the mouth are common. The skin becomes dry and rough, and ecchymoses soon appear, first on the legs and then on the arms and trunk, and particularly into and about the hair-follicles. They are petechial, but may become larger, and when subcutaneous may cause distinct swellings. In severe cases, particularly in the legs, there may be effusion between the periosteum and the bone, forming irregular nodes, which may break down and form foul-looking sores. The slightest bruise or injury causes hæmorrhages into the injured part. Œdema about the ankles is common. The "scurvy sclerosis," seen oftenest in the legs, is a remarkable infiltration of the subcutaneous tissues and muscles, forming a brawny induration, the skin over which may be blood-stained. Hæmorrhages from the mucous membranes are less constant; ~~urine~~

tous; epistaxis is, however, frequent. Hæmoptysis and hæmatemesis are uncommon. Hæmaturia and bleeding from the bowels may be present in very severe cases.

Palpitation of the heart and feebleness and irregularity of the impulse are prominent symptoms. A hæmic murmur can usually be heard at the base. Hæmorrhagic infarction of the lungs and spleen has been described. Respiratory symptoms are not common. The appetite is impaired, and owing to the soreness of the gums the patient is unable to chew the food. Constipation is more frequent than diarrhœa. The urine is often albuminous. The changes in its composition are not constant; the specific gravity is high; the color is deeper. The statements with reference to the inorganic constituents are contradictory. Some authorities have found the phosphates and potassium salts to be deficient; others hold that they are increased.

There are mental depression, indifference, in some cases headache, and in the later stages delirium. Cases of convulsions, or hemiplegia, and of meningeal hæmorrhage have been described. Remarkable ocular symptoms are occasionally met with, such as night-blindness or day-blindness.

In advanced cases necrosis of the bones may occur, and in young persons even separation of the epiphyses. There are instances in which the cartilages have separated from the sternum. The callus of a recently repaired fracture has been known to undergo destruction. Fever is not present, except in the later stages, or when secondary inflammations in the internal organs appear. The temperature may, indeed, be sometimes below normal. Acute arthritis is an occasional complication.

Diagnosis.—No difficulty is met in the recognition of scurvy when a number of persons are affected together. In isolated cases, however, the disease is distinguished with difficulty from certain forms of purpura. The association with manifest insufficiency in diet, and the rapid amelioration with suitable food, are points by which the diagnosis can be readily settled.

Prognosis.—The outlook is good, unless the disease is far advanced and the conditions persist which lead to its occurrence. The mortality now is rarely great. Death results from gradual heart-failure, occasionally from sudden syncope. Meningeal hæmorrhage, extravasation into the serous cavities, entero-colitis, and other intercurrent affections may prove fatal.

Prophylaxis.—The regulations of the Board of Trade require that a sufficient supply of antiscorbutic articles of diet be taken on each ship; so that now, except as the result of accident, the occurrence of scurvy is rare in sailors.

Treatment.—The juice of two or three lemons daily and a diet of plenty of meat and fresh vegetables suffice to cure all cases of scurvy, unless far advanced. When the stomach is much disordered, small quantities of scraped meat and milk should be given at short intervals, and the lemon-juice in gradually increasing quantities. As the patient gains in strength the diet may be more liberal, and he may eat freely of potatoes, cabbage, water-cresses, and lettuce. The stomatitis is the symptom which causes the greatest distress. A permanganate of potash or dilute carbolic acid solution forms the best mouth-wash. Pencilling the swollen gums with a tolerably strong solution of nitrate of silver is very useful. The solution is better than the solid stick, as it reaches to the crevices between the granulations. The constipation which

occur

Hess. J.A.M.A. 1915. 65. 1003

heart-sounds enlarged. mat of vessels.

oedema of eyelids, labia.

simulate beriberi = helped by addition of pericardial extract.

[illegible] cases which have only recently

abs. J.A.M.A. 1917. 68. 235

urban heart broadened - ecch. vessels

rabbit's ophthalmic reaction

app. a simple toxic condition

perhaps due to vegetable diet

reflexes ans t. -

changes in optic disk...

orange juice - protein

is so common is best treated with large enemata. For other conditions, such as hæmorrhages and ulcerations, suitable measures must be employed.

INFANTILE SCURVY

(*Barlow's Disease*)

A special form of scurvy occurs in children in consequence of imperfect food supply.

W. B. Cheadle and Gee, in London, described in very young children a cachexia associated with hæmorrhage. Cheadle regarded the cases as scurvy ingrafted on a rickety stock. Gee called his cases periosteal cachexia. Cases had previously been regarded as acute rickets.

A few years later Barlow made an exhaustive study of the condition with careful anatomical observations. The affection is now recognized as infantile scurvy, and is called Barlow's disease. The American Pædiatric Society collected 379 cases in 1898 in the United States. Of these, the hygienic surroundings were good in 303. A majority of the patients were under twelve months. The proprietary foods, particularly malted milk and condensed milk, seem to be the most important factors in producing the disease. There are instances in which it has developed in breast-fed infants, and in others fed on the carefully prepared milk of the Walker-Gordon laboratories.

The following clinical summary is taken from Barlow's description:

"So long as it is left alone the child is tolerably quiet; the lower limbs are kept drawn up and still; but when placed in its bath or otherwise moved there is continuous crying, and it soon becomes clear that the pain is connected with the lower limbs. At this period the upper limbs may be touched with impunity, but any attempt to move the legs or thighs gives rise to screams. Next, some obscure swelling may be detected, first on one lower limb, then on the other, though it is not absolutely symmetrical. . . . The swelling is ill-defined, but is suggestive of thickening round the shafts of the bones, beginning above the epiphyseal junctions. Gradually the bulk of the limbs affected becomes visibly increased. . . . The position of the limbs becomes somewhat different from what it was at the outset. Instead of being flexed they lie everted and immobile, in a state of pseudo-paralysis. . . . About this time, if not before, great weakness of the back becomes manifest. A little swelling of one or both scapulæ may appear, and the upper limbs may show changes. These are rarely so considerable as the alterations in the lower limbs. There may be swelling above the wrists, extending for a short distance up the forearm, and some swelling in the neighborhood of the epiphyses of the humerus. There is symmetry of lesions, but it is not absolute; and the limb affection is generally consecutive, though the involvement of one limb follows very close upon another. The joints are free. In severe cases another symptom may now be found—namely, crepitus in the regions adjacent to the junctions of the shafts with the epiphyses. The upper and lower extremities of the femur, and the upper extremity of the tibia, are the common sites of such fractures; but the upper end of the humerus may also be so affected. . . . A very startling appearance may be observed at this period in the front of the chest. The sternum, with the adjacent costal cartilages

and a small portion of the contiguous ribs, seems to have sunk bodily back, *en bloc*, as though it had been subjected to some violence which had fractured several ribs in the front and driven them back. Occasionally thickenings of varying extent may be found on the exterior of the vault of the skull, or even on some of the bones of the face. . . . Here also must be mentioned a remarkable eye phenomenon. There develops a rather sudden proptosis of one eyeball, with puffiness and very slight staining of the upper lid. Within a day or two the other eye presents similar appearances, though they may be of less severity. The ocular conjunctiva may show a little ecchymosis, or may be quite free. With respect to the constitutional symptoms accompanying the above series of events the most important feature is the profound anæmia which is developed. . . . The anæmia is proportional to the amount of limb involvement. As the case proceeds there is a certain earthy-colored or sallow tint, which is noteworthy in severe cases, and when once this is established bruise-like ecchymoses may appear, and more rarely small purpura. Emaciation is not a marked feature, but asthenia is extreme and suggestive of muscular failure. The temperature is very erratic; it is often raised for a day or two, when successive limbs are involved, especially during the tense stage, but is rarely above 101° or 102° F. At other times it may be normal or subnormal." If the teeth have appeared the gums may be spongy.

In young children with difficulty in moving the lower limbs, or in whom paralysis is suspected, the condition should always be looked for. What is known sometimes as Parrot's disease, or syphilitic pseudo-paralysis, may be confounded with it. In it the loss of motion is more or less sudden in the upper or lower limbs, or in both, due to a solution of continuity and separation of the cartilage at the end of the diaphysis. There are usually crepitation and much pain on movement.

The essential lesion is a subperiosteal blood extravasation, which causes the thickening and tenderness in the shafts of the bones. In some instances there is hæmorrhage in the intramuscular tissue.

The prophylaxis is most important. The various proprietary forms of condensed milk and preserved foods for infants should not be used. The fresh cow's milk should be substituted, and a teaspoonful of meat-juice or gravy may be given with a little mashed potato. Orange-juice or lemon-juice should be given three or four times a day. Recovery is usually prompt and satisfactory.

VI. OBESITY

Definition.—A disorder of metabolism characterized by excessive deposit of fat in the body.

Etiology.—Corpulence, an overgrowth of the bodily fat, an "oily dropsy," as Byron termed it, is a common condition which may be a source of great bodily and mental distress. Primarily it results from inadequate oxidation of the food stuffs, associated either with excessive absorption of the materials which produce fat, or with incomplete combustion. Both factors probably take part. It is not always due to excessive intake of food; many stout persons are light eaters. On the other hand, there are cases in which the increase in weight is directly due to an excessive consumption of food. There is a

marked hereditary tendency. Certain races are prone to obesity, and women are more often affected than men.

Fat metabolism is as yet imperfectly understood; it is under the control of the internal secretions. We see the deposition of fat in connection with many processes with which the internal secretions are concerned. At puberty there is a great increase in the fat deposits, particularly of the skin. Following castration there is an increase in the amount of subcutaneous fat. Eunuchs as a rule are very stout. At the menopause increase in weight is common, and during both pregnancy and lactation the subcutaneous fat may be greatly increased.

In only one point have we positive knowledge as to the internal secretions controlling fat metabolism. It has been known that tumors of the pituitary gland or in its neighborhood may be associated with general adiposity and sexual infantilism (Frölich's syndrome). The studies of Cushing and his students have shown that the pituitary body controls carbohydrate metabolism, and that with the removal of the posterior lobe there is a great increase in the body weight. There seems to be a definite hypophysial syndrome of increased tolerance for carbohydrates with adiposity. ~~It is not unlikely that~~ many of the cases of extreme obesity in young persons are due to hypopituitarism. The remarkable acute obesity, in which as much as 70 pounds ~~in weight~~ may be gained in six months, probably depends upon perversions of some internal secretions.

Symptoms.—Inconvenience caused by the bulk, and loss of good looks in women, are the features for which we are usually consulted. While fat is no sign of health, the great bulk may be consistent with remarkable vigor and activity. Shortness of breath, embarrassed cardiac action, difficulty in walking are the most common complaints. In children obesity is very often associated with careless habits in eating and lack of proper control on the part of parents. The condition is increasing, particularly in the United States, where one sees an extraordinary number of very stout children. A remarkable phenomenon associated with excessive fat in young persons is an uncontrollable tendency to sleep—like the fat boy in Pickwick. It is ~~quite possible~~ that puberty this narcolepsy is also a manifestation of disturbed internal secretions.

Treatment.—In women obesity is a very distressing state, accompanied with all sorts of inconveniences and discomforts. With a marked hereditary tendency not much can be expected. The famous George Cheyne, who was a man of enormous bulk, reduced himself by dieting from thirty-two stones (448 pounds) to proper dimensions. One of his aphorisms says: "Every wise man after Fifty ought to begin and lessen at least the quantity of his Aliment, and if he would continue free from great and dangerous Distempers and preserve his Senses and Faculties clear to the last, he ought every seven years to go on abating gradually and sensibly, and at last descend out of life as he ascended into it, even into a Child's Diet." Put in other words, it reads —We eat too much after forty years of age.

In the case of children very much may be done by regulating the diet, reducing the starches and fats in the food, not allowing them to eat sweets, and encouraging systematic exercises. In the case of women who tend to grow stout after child-bearing or at the climacteric, in addition to systematic exercises, they should be told to avoid taking too much food, and particularly to

reduce the starches and sugars. There are a number of methods or systems in vogue at present. In the celebrated one of Banting the carbohydrates and fats were excluded and the amount of food was greatly reduced.

Oertel's method is given under the treatment of fatty heart. He reduces the amount of liquid taken, and this is practically, too, the so-called Schweninger cure, in which liquids are allowed only two hours after the food.

Von Noorden's dietary is as follows: Eight o'clock, 80 grams of lean, cold meat, 25 grams of bread, one cup of tea, with a spoonful of milk, no sugar. Ten o'clock, one egg. Twelve o'clock, a cup of strong meat broth. One o'clock, a small plate of meat soup flavored with vegetables, 150 grams of lean meat of one or two sorts, partly fish, partly flesh, 100 grams of potatoes with salad, 100 grams of fresh fruit, or compote without sugar. Three o'clock, a cup of black coffee. Four o'clock, 200 grams of fresh fruit. Six o'clock, a quarter of a litre of milk, if desired, with tea. Eight o'clock, 125 grams of cold meat, or 180 grams of meat weighed raw and grilled, and eaten with pickles or radishes and salad, 30 grams of Graham bread, and two or three spoonfuls of cooked fruit without sugar. He believes it more satisfactory to give in addition to the three meals smaller quantities of food at shorter intervals, so as to obviate the tendency to weakness which these patients often experience. In addition he allows twice in the day a glass of wine. The use of mineral water, weak tea, or lemonade is not limited at the meal times or in the intervals. An occasional "hunger-day" is given.

In the treatment of extreme obesity it is very much better that the patient should be in hospital, or under the care of a nurse, who will undertake the proper weighing and administration of the food. The amount of fluid ingested should not be reduced below one litre a day. Many of these patients are anæmic, even with a florid appearance, and for them iron in full doses is advisable.

The thyroid extract should be used only in a systematic "cure." Five grains three times a day is a sufficient dose. In conjunction with the diet and exercises it is useful, but it should not be ordered indiscriminately to fat persons. Pituitary gland extracts have also been used.

VII. THE LIPOMATOSES

Various forms of localized deposits of fat may be considered here, and I follow the division in Lyon's thorough study of these conditions (*Archives of Internal Medicine,* VI, 1).

I. Adiposis Dolorosa (*Dercum's Disease*).—In the words of the original description this is a disorder characterized by irregular symmetrical deposits of fatty masses in various portions of the body, preceded or attended by pain, and associated sometimes with asthenia and psychical changes.

The lipomatous masses are diffuse and symmetrical, involving the abdomen, chest, arms or legs; or localized on the limbs or trunk. The hands, face and feet are usually spared. The pain is sometimes spontaneous and is easily excited by pressure. Asthenia, not always present, may be a marked feature. The patients are often irritable, and the French writers have described cases with mental changes. Sometimes the skin over the areas of infiltration is

markedly hyperæsthetic. The affection is more common in females. Nine or ten autopsies have been made, none of which threw clear light on the pathology. Quite possibly it is a disturbance of the internal secretions.

II. Nodular Circumscribed Lipomatosis.—The cases are common. The lipomata are distributed in various localities and vary in size from small encapsulated nodules to large circumscribed tumors, solitary or multiple, sometimes symmetrically placed. They may be painful, and Lyon calls attention to the fact that the accessory features of asthenia and psychical changes may also be present.

III. Diffuse Symmetrical Lipomatosis of the Neck.—This remarkable affection, also called adeno-lipomatosis, is characterized by symmetrical fatty infiltrations, either simple or lobulated, of the subcutaneous tissues, forming a huge collar about the neck. It may occur in this part alone, or other limited lipomata are found elsewhere. Males are much more frequently attacked than females. The tumors interfere but little with health, but as they increase the condition becomes very disfiguring. There are sometimes constitutional symptoms. The name "*adeno*-lipomatosis" has been given because scattered throughout the diffuse fatty masses there are small firm nodules of lymphatic tissue—sometimes hæmo-lymph glands.

IV. Cerebral Adiposity (*Dystrophia Adiposo-Genitalis. Frölich*).—~~As already mentioned,~~ a condition of obesity may occur in connection with tumors of the hypophysis, or adjacent parts, associated with a hypoplasia of the genital organs and a condition of infantilism. The condition will be ~~further~~ discussed in the section on internal secretions, as it ~~would~~ appears from the researches of Cushing to be associated with the perversion of the function of the pituitary gland.

V. Pseudo-Lipoma.—Sydenham made the keen observation that in hysterical patients there were sometimes swellings, which neither yielded to the impress of the finger nor left a mark. Charcot described the condition as "hysterical œdema," of which there is both a blue and a white variety.

Many of these subcutaneous infiltrations, just as in the soft, supraclavicular pad, so common in stout women, are due to fat, and French writers describe all grades of transition from a pseudo-œdema to a true lipoma.

Treatment.—This is not satisfactory. A trial of thyroid extract in small doses is advisable, but it is well to suspend its use for a week in every month. Extracts of other glands may also be tried. In patients with signs of tumor of the hypophysis surgical measures should be considered.

VIII. HÆMOCHROMATOSIS

Definition.—A disorder of metabolism characterized by a deposition of an iron containing pigment in the glandular organs, and by an increase in the normal pigmentation with which is associated a progressive sclerosis of various organs, and, in a large proportion of the cases, diabetes. The disease was first described by von Recklinghausen.

Etiology.—There are about 60 cases on record (1911), all, with the exception of about a dozen, with diabetes. Only one occurred in a woman. In the majority of the patients, middle-aged men, there seemed to be no marked

predisposing causes, though Blumer ~~in a recent study~~ maintains that alcohol plays an important part.

Pathology.—On autopsy the ochre or bronze color of the organs is the striking feature. The liver is large and sclerotic; the spleen also enlarged, and the pancreas either small and atrophic or fatty and fibroid. The lymph nodes are also pigmented. The pigment is hæmosiderin or iron-reacting. It is chiefly in the cells of the glands, in the muscle cells of the heart, and in the lymph nodes. The amount in the various organs is enormous, a hundred times the normal in the liver, for example. The hæmofuscin, the non-iron-reacting pigment, varies in different amounts, and it has a yellow tint, and is found chiefly in the connective tissue cells. The blood shows no special changes.

The pathogenesis ~~of the disease~~ is obscure, and Sprunt, whose ~~recent~~ study (*Archives of Internal Medicine*, July, 1911) contains an admirable summary of our knowledge, concludes that there is no evidence of abnormal blood destruction, and that it is a primary disorder of metabolism, "implicating many of the body tissues, and manifested by a change in the chromogenic groups of the proteid molecule with the deposition of pigments."

Clinical Features.—There are two groups of cases, the larger one in which diabetes is present, and the smaller in which there is no sugar in the urine. The former group is spoken of by the French as *diabète bronzé*, which has the features of a severe diabetes with weakness, progressive pigmentation of the skin, and an enlarged liver. The pigmentation of the skin which is the feature that attracts attention varies in color from a dark brown to a leaden or bluish black. Dr. Maude Abbott's case was known as *Blue Mary*. The liver is in a state of hypertrophic cirrhosis, a smooth and uniform enlargement. The spleen may be enlarged secondarily. It was very large in two of my cases. The diabetes is usually severe, and runs a rapid course. Prior to the onset of diabetes the disease may last for years.

There is no special treatment beyond measures for the general health; in the patients with diabetes the usual treatment ~~for that disease~~ should be carried out.

IX. OCHRONOSIS

Definition.—A rare disorder of metabolism associated with blackening of the cartilages and fibrous tissues and pigmentation of the skin, and the presence of dark urine due to alcapton or to derivatives of carbolic acid.

Etiology.—There are two groups of cases:

(*a*) There is a congenital life-long chemical malformation, sometimes a family affection, in which there is a failure to complete the catabolism of certain aromatic compounds, with the result that peculiar bodies, homogenistic acid and uroleucic acid are excreted in the urine, which blackens on exposure to air—alcaptonuria. The anomaly may be present in three generations.

(*b*) In the other group the dark urine and the blackening of the tissues are due to the prolonged use of carbolic acid, usually the application of strong solutions externally to ulcers. There may possibly be other causes.

Symptoms.—When well developed, ochronosis presents a very striking picture. The discoloration of the fibrous tissues is best seen about the knuckles, and in thin persons the tendons of the hands and feet show a bluish-gray ap-

Blue Mass.

Journ. of Path. & Bact. Aug. 1900. VII. 4 85

Trans. Path. Soc. of London 1900 51. 66

pearance. The cartilage of the ear has a bluish tint, and there may be symmetrical black patches on the sclerotics. Widespread pigmentation of the skin has been observed. In one of my patients there was a coal-black discoloration of the skin over the nose and cheeks, and the same was beginning in the hands. This may occur also in the carboluria group, as well shown in the colored illustration of Dr. Pope's patient. Several of the reported cases had arthritis, and the two brothers in the Maryland family had a curious anterior inclination of the trunk, and a peculiar waddling gait. There are few symptoms directly due to the chemical malformation. The patients enjoy good health, but the disfigurement may be very great. Post mortem, the appearance is remarkable, as pictured in Virchow's original case; the cartilages, ligaments and fibrous structures are everywhere of a brown-black color.

SECTION V

DISEASES OF THE DIGESTIVE SYSTEM

A. DISEASES OF THE MOUTH

STOMATITIS

Acute Stomatitis.—Simple or erythematous stomatitis, the commonest form, results from the action of irritants of various sorts. Frequent at all ages, in children it is usually associated with dentition and with gastro-intestinal disturbance, particularly in ill-nourished, unhealthy subjects; in adults it may follow the abuse of tobacco, or the use of too hot or too highly seasoned food; it is a concomitant of indigestion, or of the specific fevers.

The affection may be limited to the gums and lips or may extend over the whole surface of the mouth and include the tongue. There are at first superficial redness and dryness of the membrane, followed by increased secretion and swelling of the tongue, which is furred, and indented by the teeth. There is rarely any constitutional disturbance, but in children there may be slight elevation of temperature. The condition causes considerable discomfort, sometimes amounting to actual distress and pain, particularly in mastication.

In infants the mouth should be carefully sponged after each feeding. A mouth-wash of borax or glycerin and borax may be used, and in severe cases, which tend to become chronic, a dilute solution of nitrate of silver (3 or 4 grains to the ounce) may be applied.

Aphthous Stomatitis.—This form, also known as *follicular* or *vesicular* stomatitis, is characterized by the presence of small, slightly raised spots, from 2 to 4 mm. in diameter, surrounded by reddened areolæ. The spots appear first as vesicles, which rupture, leaving small ulcers with grayish bases and bright-red margins. They are seen most frequently on the inner surfaces of the lips, the edges of the tongue, and the cheeks. They are seldom present on the mucous membrane of the pharynx. This form is met with most often in children under three years, either as an independent affection or in association with one of the febrile diseases of childhood or with an attack of indigestion. The vesicles come out with great rapidity and the little ulcers may be fully formed within twenty-four hours. The child complains of soreness of the mouth and takes food with reluctance. The buccal secretions are increased and the breath is heavy, but not foul. The constitutional symptoms are usually those of the disease with which the aphthæ are associated. The disease must not be confounded with thrush. No special parasite has been found in connection with it. It is not a serious condition, and heals rapidly

with the improvement of the constitutional state. In severe cases it may extend to the pillars of the fauces and to the pharynx, and produce ulcers which are irritating and difficult to heal.

Each ulcer should be touched with nitrate of silver and the mouth should be thoroughly cleansed after taking food. A wash of chlorate of potassium, or of borax and glycerin, may be used. The constitutional symptoms should receive careful attention.

A curious affection occurs in southern Italy sometimes in epidemic form, characterized by a pearly-colored membrane with induration, immediately beneath the tongue on the frænum (Riga's disease). There may be much induration and ultimately ulceration. It occurs in both healthy and cachectic children, usually about the time of the eruption of the first teeth.

Ulcerative Stomatitis.—This form, which is also known by the names of *fetid stomatitis*, or *putrid sore mouth*, occurs particularly in children after the first dentition. It may prevail as a widespread epidemic in institutions in which the sanitary conditions are defective. It has been met with in jails and camps. Insufficient and unwholesome food, improper ventilation, and prolonged damp, cold weather seem to be special predisposing causes. Lack of cleanliness of the mouth, the presence of carious teeth, and the collection of tartar around them favor the occurrence of the disease. The affection spreads like a specific disease, but the microbe has not yet been isolated. It has been held that the disease is the same as the foot-and-mouth disease of cattle, and that it is conveyed by the milk, but there is no positive evidence on these points.

The morbid process begins at the margin of the gums, which become swollen and red, and bleed readily. Ulcers form, the bases of which are covered with a grayish-white, firmly adherent membrane. In severe cases the teeth may become loosened and necrosis of the alveolar process may occur. The ulcers extend along the gum-line of the upper and lower jaws; the tongue, lips, and mucosa of the cheeks are usually swollen, but rarely ulcerated. There is salivation, the breath is foul, and mastication is painful. The submaxillary lymph-glands are enlarged. An exanthem may appear and be mistaken for measles. The constitutional symptoms are often severe, and in debilitated children death sometimes occurs.

In the treatment of this form of stomatitis chlorate of potassium has been found to be almost specific. It should be given in doses of 10 grains (0.6 gm.), three times a day, to a child, and to an adult double that amount. Locally it may be used as a mouth-wash, or the powdered salt may be applied directly to the ulcerated surfaces. When there is much fetor, a solution of potassium permanganate may be used as a wash, and an application of nitrate of silver made to the ulcers.

A *variety* of ulcerative sore mouth, which differs entirely from this form, is common in nursing women, and is usually seen on the mucous membrane of the lips and cheeks. The ulcers arise from the mucous follicles, and are from 3 to 5 mm. in diameter. They may cause little or no inconvenience; but in some instances they are very painful and interfere seriously with the taking of food and its mastication. As a rule they heal readily after the application of nitrate of silver, and the condition is an indication for tonics, fresh air, and a better diet.

Recurring outbreaks of an *herpetic*, even *pemphigoid*, stomatitis are seen in neurotic individuals (*stomatitis neurotica chronica*, Jacobi). It may precede or accompany the fatal form of *pemphigus vegetans*.

Parrot describes the occasional appearance in new-born, debilitated children of small ulcers symmetrically placed on the hard palate on either side of the middle line. They rarely heal, but tend to increase in size, and may involve the bone.

Bednar's aphthæ consist of small patches and ulcers on the hard palate, caused as a rule in young infants by the artificial nipple or the nurse's finger.

Parasitic Stomatitis (*Thrush; Soor; Muguet*).—This affection, most commonly seen in children, is dependent upon a fungus, *Saccharomyces albicans*, called by Robin *Oïdium albicans*. It belongs to the order of yeast fungi, and consists of branching filaments, from the ends of which ovoid torula cells develop. The disease does not arise apparently in a normal mucosa. ~~The use of~~ an improper diet, uncleanliness of the mouth, ~~the acid~~ fermentation of remnants of food, or the occurrence, from any cause, of catarrhal stomatitis predispose to the growth. In institutions it is frequently transmitted by unclean feeding-bottles, spoons, etc. It is not confined to children, but is met with in adults in the final stages of fever, in chronic tuberculosis, diabetes, and in cachectic states. The parasite grows in the upper layers of the mucosa, and the filaments form a dense felt-work among the epithelial cells. The disease begins on the tongue and is seen in the form of slightly raised, pearly-white spots, which increase in size and gradually coalesce. The membrane thus formed can be readily scraped off, leaving an intact mucosa, or, if the process extends deeply, a bleeding, slightly ulcerated surface. The disease spreads to the cheeks, lips, and hard palate, and may involve the tonsils and pharynx. In very severe cases the entire buccal mucosa is covered by the grayish-white membrane. It may even extend into the œsophagus and to the stomach and cæcum. It is occasionally met with on the vocal cords. Robust, well-nourished children are sometimes affected, but it is usually met with in enfeebled, emaciated infants with digestive or intestinal troubles. In such cases the disease may persist for months.

The affection is readily recognized, and must not be confounded with aphthous stomatitis, in which the ulcers, preceded by the formation of vesicles, are perfectly distinctive. In thrush the microscopic examination shows the presence of the characteristic fungus throughout the membrane. In this condition, too, the mouth is usually dry—a striking contrast to the salivation accompanying aphthæ.

Thrush is more readily prevented than removed. The child's mouth should be kept scrupulously clean, and, if artificially fed, the bottles should be thoroughly sterilized. Lime-water or any other alkaline fluid, such as the bicarbonate of soda (a drachm to a tumbler of water), may be employed. When the patches are present these alkaline mouth-washes may be continued after each feeding. A spray of borax or of sulphite of soda (a drachm to the ounce) or the black wash with glycerine may be employed. The permanganate of potassium is also useful. The constitutional treatment is of equal importance, and it will often be found that the thrush persists, in spite of all local measures, until the general health of the infant is improved by change

of air or the relief of the diarrhœa, or, in obstinate cases, the substitution of a natural for the artificial diet.

Gangrenous Stomatitis (*Cancrum Oris; Noma*).—An affection characterized by a rapidly progressing gangrene, starting on the gums or cheeks, and leading to extensive sloughing and destruction. This terrible, but fortunately rare, disease is seen only in children under very insanitary conditions or during convalescence from the acute fevers. It is more common in girls than in boys. It is met with between the ages of two and five years. In at least one-half of the cases the disease has occurred during convalescence from measles. Cases have been seen also after scarlet fever and typhoid. The mucous membrane is first affected, usually of the gums or of one cheek. The process begins insidiously, and when first seen there is a sloughing ulcer of the mucous membrane, which spreads rapidly and leads to brawny induration of the skin and adjacent parts. The sloughing extends, and in severe cases the cheek is perforated. The disease may spread to the tongue and chin; it may invade the bones of the jaws and even involve the eyelids and ears. In mild cases an ulcer forms on the inner surface of the cheek, which heals or may perforate and leave a fistulous opening. Naturally in such a severe affection the constitutional disturbance is very great, the pulse is rapid, the prostration extreme, and death usually takes place within a week or ten days. The temperature may reach 103° or 104° F. Diarrhœa is usually present, and aspiration pneumonia is a common complication. No specific organism has been found.

In many cases the onset is so insidious that there is an extensive sloughing sore when the case first comes under observation. Destruction of the sore by the Paquelin cautery or fuming nitric acid is the most effectual. Antiseptic applications should be made to destroy the fetor. The child should be carefully nourished and stimulants given freely.

Mercurial Stomatitis (*Ptyalism*).—It occurs in persons with a special susceptibility, rarely now as a result of the excessive use of the drug, and also in those whose occupation necessitates the constant handling of mercury. It may follow the administration of repeated small doses. Thus, a patient with heart-disease who was ordered an eighth of a grain of calomel every three hours for diuretic purposes had, after taking eight or ten doses, a severe stomatitis, which persisted for several weeks. I have known it to follow the administration of small doses of gray powder. The patient complains first of a metallic taste in the mouth, the gums become swollen, red, and sore, mastication is difficult, the salivary glands become enlarged and painful, and there is a great increase in their secretion. The tongue is swollen, the breath has a foul odor, and, if the affection progresses, there may be ulceration of the mucosa, and, in rare instances, necrosis of the jaw. Although troublesome and distressing, the disease is rarely serious, and recovery usually takes place in a couple of weeks. Instances in which the teeth become loosened or detached or in which the inflammation extends to the pharynx and Eustachian tubes are rarely seen now.

The administration of mercury should be suspended so soon as the gums are "touched." Mild cases of the affection subside within a few days and require only a simple mouth-wash. In severer cases the chlorate of potassium may be given internally, and used to rinse the mouth. The bowels should be

freely opened; the patient should take a hot bath every evening and should drink plentifully of alkaline mineral waters. Atropine is sometimes serviceable, and may be given in doses of 1/100 of a grain twice a day. Iodine is also recommended. When the salivation is severe and protracted the patient becomes much debilitated and anæmic, so that a supporting treatment is indicated. The diet is necessarily liquid, for the patient finds the chief difficulty in taking food. If the pain is severe Dover's powder may be given at night.

Here may be appropriately mentioned the influence of stomatitis, particularly the mercurial form, upon the developing teeth of children. The condition known as *erosion*. in which the teeth are honeycombed or pitted owing to defective formation of enamel, is indicative, as a rule, of infantile stomatitis. Such teeth must be distinguished carefully from those of congenital syphilis, which may, of course, coexist, but the two conditions are distinct. The honeycombing is frequently seen on the incisors; but, according to Jonathan Hutchinson, the test teeth of infantile stomatitis are the first permanent molars, then the incisors, "which are almost as constantly pitted, eroded, and of bad color, often showing the transverse furrow which crosses all the teeth at the same level." Magitot regards these transverse furrows as the result of infantile convulsions or of severe illness during early life. He thinks they are analogous to the furrows on the nails which so often follow a serious disease.

Geographical Tongue (*Eczema of the Tongue*).—A remarkable desquamation of the superficial epithelium of the tongue in circinate patches, which spread while the central portions heal. Fusion of patches leads to areas with sinuous outlines. When extensive the tongue may be covered with these areas, like a geographical map. The affection causes a good deal of itching and heat, and it may be a source of much mental worry to the patients, who often dread lest it may be a commencing cancer.

The etiology of the disease is unknown. It occurs in infants and children, and it is not very infrequent in adults. It has been regarded as a gouty manifestation, and transient attacks may accompany indigestion. It is very liable to relapse. In adults it may prove very obstinate, and I know of one instance in which the disease persisted in spite of all treatment for more than two years. Solutions of nitrate of silver give the most satisfactory results in relieving the intense burning.

There is a superficial glossitis, limited usually to the border and point of the tongue, which presents irregular reddish spots, looking as if the epithelium was removed, and the papillæ are reddened and swollen. The condition is sometimes known as Möller's glossitis. Local treatment with nitrate of silver as a rule gives relief.

Leukoplakia Buccalis.—Samuel Plumbe described the condition as *ichthyosis lingualis*. It has also been called *buccal psoriasis* and *leuco-keratosis mucosæ oris*. The following forms occur: (*a*) Small white spots upon the tongue, slightly raised, even papillomatous—lingual corns. (*b*) Diffuse thickening of the epithelial coating of the tongue, either a thin, bluish-white color or opaque white, depending upon the thickness. It is patchy, and more often upon the dorsum and sides. (*c*) Diffuse oral leukoplakia, a remarkable condition in which the roof of the mouth, the gums, lips, and cheeks are covered with an opaque white, sometimes smooth, sometimes fissured, rugose layer.

In this widespread form the tongue may be spared. The visible mucosa of the lips may be involved, and occasionally the genital mucosa.

While appearing spontaneously, the condition is most common in heavy smokers, and has been called smoker's tongue. Epithelioma occasionally starts from the localized patches. A majority of the patients have had syphilis, but the condition does not yield, as a rule, to specific treatment.

Leukoplakia is a very obstinate affection. All irritants, such as smoke and very hot food, should be avoided. Local treatment with one-half-per-cent. corrosive sublimate or a one-per-cent. chromic-acid solution has been recommended. The propriety of active local treatment is doubtful. Papillomatous outgrowths should be cut off. The X-rays may be tried. The most extensive form may disappear spontaneously.

The *glossy flat atrophy* of the posterior part of the tongue, described by Virchow, is in a majority of instances of syphilitic origin. Scars may give an irregular appearance to the surface. Symmers found this smooth atrophy in 55 of 75 post mortems in syphilitic subjects.

Fetor Oris.—The practitioner is frequently consulted for foul breath, and is daily made aware of its widespread prevalence. All unconscious, he is himself too often subject of the condition, to the disgust of his patients, with whom he has to come into such close contact. It is impossible to give even a list of all the causes mentioned. The following are a few of the more important: (*a*) In connection with indigestion and the associated catarrhal disturbances in the mouth, pharynx, and stomach. The breath is "heavy," as the mothers say. A simple mouth-wash and a mercurial purge suffice to remove it. In a more serious disease of the stomach the breath may be foul, and occasionally, in sloughing cancer, horribly stinking. (*b*) Local conditions in the mouth: (1) All the forms of stomatitis. Smokers should remember that, apart altogether from the smell of tobacco, their breath in the morning is usually, to say the least, "heavy." (2) Pyorrhœa alveolaris. This is the most common cause of foul breath in adults, and is almost constantly present after middle life, causing a perfectly distinctive odor only too well known to all of us. To test for the presence draw a bit of stout thread or the edge of a sheet of paper high up between the teeth and the gums and then smell it. Scrupulous treatment of the gums by a dentist is needed, and daily scouring, etc. (*c*) The tonsillar diseases. In the crypts of the tonsils the epithelial débris accumulates, and, invaded by micro-organisms, gradually forms the little round or triangular bodies which can be squeezed out of the lacunæ, and when pressed between the fingers smell like Limburger cheese. The fetor oris from this cause is quite distinctive. To test the presence in child or adult, smell the finger after it has been rubbed firmly upon the tonsil. Local treatment is needed. (*d*) Decayed teeth, the foul odor of which is quite distinct from that of pyorrhœa or chronic tonsillitis. (*e*) Respiratory. Many diseases of the nose, larynx, bronchi, and lungs are associated with foul breath. (*f*) Hæmic. The halitus—the expired air from the lung—may be impregnated with odors from the blood. Of this there are many well-known instances.

For practical purposes it is to be remembered that pyorrhœa alveolaris and what is called chronic lacunar tonsillitis are the two most common causes of foul breath.

Oral Sepsis.—To William Hunter, of Charing Cross Hospital, is due the credit of insisting upon the importance of the mouth as the chief channel of entrance of the pyogenic organisms, and as itself the seat of septic processes. Necrosed teeth, pyorrhœa alveolaris, gingivitis, alveolar abscess, etc., are present in a great many people. A systemic infection may follow or the general health may be lowered by the continuous production of pus. In extensive pyorrhœa alveolaris the daily amount of pus must be considerable, and there can be no question that it has a debilitating influence on the general health and is sometimes associated with a moderate anæmia and with a pasty complexion. Hunter describes septic gastritis and septic enteritis as common sequences; indeed, he regards appendicular, pleuritic, gall-bladder and pyelitic inflammations as forms of "medical sepsis" due largely to infection from the mouth. One form of pernicious anæmia—infective hæmolytic anæmia—he believes to be due to oral sepsis, or an infective glossitis. Certain types of nephritis and forms of arthritis are believed to be due to oral infection.

There is no question of the importance of the subject, and we should insist upon scrupulous cleanliness of the mouth and teeth, particularly clearing away the tartar and the pockets of pus. An adult should have his teeth cleansed in this way by a dentist once a month. We should, too, have less delicacy in telling our friends in whom the odor of the breath reveals the presence of pyorrhœa. It is a very difficult condition to cure. Locally much may be done to keep it under control. Vaccines have been used extensively, sometimes, but not always, with success. If possible, the patient should be referred to a dentist who is specially competent to deal with it. The tartar should be removed from the teeth and antiseptic mouth washes, such as carbolic acid (1 per cent.), used frequently. Hydrogen peroxide may be applied locally.

Affections of the mucous glands are not very common. In catarrhal troubles in children and in measles they may be swollen. They are enlarged and very prominent in Mikulicz's disease, with chronic symmetrical enlargement of the salivary and lachrymal glands. There is a singular affection of the mucous glands of the lips, chiefly of the lower, with much swelling and infiltration. It was described by Volkmann, and has been called Bälz's disease. The mucous glands are enlarged, the ducts much dilated, and on pressure a mucoid or muco-purulent secretion may exude. The skin over the lips may be reddened and swollen.

B. DISEASES OF THE SALIVARY GLANDS

Supersecretion (*Ptyalism*).—The normal amount of saliva varies from 2 to 3 pints in the twenty-four hours. The secretion is increased during the taking of food and in the physiological processes of dentition. A great increase, to which the term *ptyalism* is applied, is met with (1) occasionally in mental and nervous affections and in rabies; (2) occasionally in the acute fevers, particularly in small-pox; (3) sometimes with disease of the pancreas; (4) during gestation, usually early, though it may persist through the entire course; (5) occasionally at each menstrual period; and, lastly, it is a com-

or sidnic

mon effect of certain drugs—mercury, gold, copper, the iodine compounds, and (among vegetable remedies) jaborandi, muscarin, and tobacco excite the salivary secretion. Of these we most frequently see the effect of mercury in producing ptyalism. The salivation may be present without any inflammation of the mouth. For treatment atropine or the bromides may be given in small doses at first and the effect watched until the most efficient dosage is found.

Xerostomia (*Arrest of the Salivary and Buccal Secretions; Dry Mouth*).—In this condition, first described by Jonathan Hutchinson, the secretions of the mouth and salivary glands are suppressed. The tongue is red, sometimes cracked, and quite dry; the mucous membrane of the cheeks and of the palate is smooth, shining, and dry; and mastication, deglutition, and articulation are very difficult. A majority of the cases are in women, and in several instances have been associated with nervous phenomena. The general health, as a rule, is unimpaired. It may be due to involvement of some centre which controls the secretion of the salivary and buccal glands. The free use of glycerin locally is sometimes of value and jaborandi or pilocarpine can be given cautiously.

Inflammation of the Salivary Glands.

(*a*) *Specific Parotitis.* (See Mumps.)

(*b*) *Symptomatic parotitis* or *parotid bubo* occurs:

(1) In the course of the infectious fevers—typhus, typhoid, pneumonia, pyæmia, etc. In ordinary practice it occurs oftenest, perhaps, in typhoid fever. It is the result either of septic infection through the blood, or the inflammation, in many cases, passes up the salivary duct, and so reaches the gland. The process is usually very intense and leads rapidly to suppuration. It is, as a rule, an unfavorable indication in the course of a fever. Parotitis may occur in secondary syphilis.

(2) In connection with injury or disease of the abdomen or pelvis, a condition to which Stephen Paget has called special attention. Of 101 cases of this kind, "10 followed injury or disease of the urinary tract, 18 were due to injury or disease of the alimentary canal, and 23 were due to injury or disease of the abdominal wall, the peritoneum, or the pelvic cellular tissue. The remaining 50 were due to injury, disease, or temporary derangement of the genital organs." By temporary derangement is meant slight injuries or natural processes—a slight blow on the testis, the introduction of a pessary, menstruation, or pregnancy. Bucknell has brought forward strong evidence to show that in all these cases infection takes place through the duct.

(3) In association with facial paralysis, as in a case of fatal peripheral neuritis described by Gowers; in diabetes and chronic metallic poisoning.

In the infectious diseases rigid cleanliness is an important preventive measure. In the treatment of parotitis the application of half a dozen leeches will sometimes reduce the inflammation and promote resolution. An ice bag often aids, or hot fomentations may be applied. A free incision should be made *early* if there are signs of suppuration.

(*c*) *Chronic parotitis*, a condition in which the glands are enlarged, rarely painful, may follow inflammation of the throat or mumps. Salivation may be present. It may be due to lead, mercury, or potassium iodide. It occurs also in chronic Bright's disease and in secondary syphilis. Symmetrical en-

largement of the parotids of moderate extent is not very uncommon among hospital patients. The cases at the Johns Hopkins clinic have been reported by C. P. Howard (*Internat. Clinics.*, xix, 1). It may be associated with xerostomia. The parotid and submaxillary glands are affected with equal frequency. In one case the swelling recurred over a period of 20 years (Greig).

(*d*) *Mikulicz's Disease.*—In this remarkable affection, described in 1888 the salivary and lachrymal glands are enlarged simultaneously. The condition is painless and chronic, lasting sometimes for several years, and of unknown etiology. The gland substance itself may not be disturbed, but there is a great infiltration of the interstitial connective tissue. In my case the lachrymal glands were replaced by fibrous tissue. The cases so far reported in America have been in negroes. The enlargement may subside after an acute fever. Good results have followed the use of arsenic.

(*e*) *Gaseous Tumors of Steno's Duct and of the Parotid Gland.*—In glass-blowers and musicians Steno's duct may become inflated with air and form a tumor the size of a nut or of an egg. Some have contained a mixture of air, saliva, and pus. In rare cases there are gaseous tumors of the glands, which give a sensation of crepitation on palpation.

C. DISEASES OF THE PHARYNX

Circulatory Disturbances.—(*a*) *Hyperæmia* is common in acute and chronic affections of the throat, and is frequently seen as a result of the irritation of tobacco smoke, and from the constant use of the voice. Venous stasis is seen in valvular disease of the heart, and in mechanical obstruction of the superior vena cava by tumor or aneurism. In aortic insufficiency the capillary pulse may sometimes be seen, and the intense throbbing of the internal carotid may be mistaken for aneurism.

(*b*) *Hæmorrhage* is found in association with bleeding from other mucous surfaces, or it is due to local causes—granulations, varicosities, or vegetations. It may be mistaken for hæmorrhage from the lungs or stomach. Sometimes the patient finds the pillow stained in the morning with bloody secretion. The condition is rarely serious, and requires only suitable local treatment. Occasionally a hæmorrhage takes place into the mucosa, producing a pharyngeal hæmatoma. I have thrice seen a condition of the uvula resembling hæmorrhagic infarction. One was in a patient with rheumatic fever, to whom large doses of salicylic acid had been given; the other two were instances of peliosis rheumatica, in both of which partial sloughing of the uvula took place.

(*c*) *Œdema.*—An infiltrated œdematous condition of the uvula and adjacent parts is not very uncommon in conditions of debility, in profound anæmia, and in ~~Bright's disease~~ Bright's. The uvula is sometimes enormously enlarged from this cause, whence may arise difficulty in swallowing or in breathing.

Acute Pharyngitis (*Sore Throat; Angina Simplex*).—The entire pharyngeal structures, often with the tonsils, are involved. The condition may follow cold or exposure. In other instances it is associated with constitutional states, such as gout, or with digestive disorders. The patient complains of uneasiness and soreness in swallowing, of a feeling of tickling and dryness

M. Dr. chronic indolent asymmetrical — Tr. arsenic - iodide & X ray.
prob. many an tuberculous or luetic. prob. not [illegible]
affec. cathipalsii [illegible]

in the throat, together with a constant desire to hawk and cough. Frequently the inflammation extends into the larynx and produces hoarseness. Not uncommonly it is only part of a general naso-pharyngeal catarrh. The process may pass into the Eustachian tubes and cause slight deafness. There is stiffness of the neck, the lymph-glands of which may be enlarged and painful. The constitutional symptoms are rarely severe. The disease sets in with a chilly feeling and slight fever; the pulse is increased in frequency. Occasionally the febrile symptoms are more severe, particularly if the tonsils are specially involved. The examination of the throat shows general congestion of the mucous membrane, which is dry and glistening, and in places covered with sticky secretion. The uvula may be much swollen.

Acute pharyngitis lasts only a few days and requires mild measures. Cold compresses or an ice bag may be applied to the neck. If the tonsils are involved and the fever is high, aconite or sodium salicylate may be given. Guaiacum also is beneficial; but in a majority of the cases a calomel purge or a saline aperient and simple inhalations meet the indications.

Chronic Pharyngitis.—This may follow repeated acute attacks. It is very common in persons who smoke or drink to excess, and in those who use the voice very much, such as clergymen, hucksters, and others. It is frequently associated with chronic nasal catarrh. The naso-pharynx and the posterior wall are the parts most frequently affected. The mucous membrane is relaxed, the venules are dilated, and roundish bodies, from 2 to 4 mm. in diameter, reddish in color, project to a variable distance beyond the mucous membrane. These represent the proliferations of lymph tissue about the mucous glands. They may be very abundant, forming elongated rows in the lateral walls of the pharynx. With this there may be a dry glistening state of the pharyngeal mucosa, sometimes known as *pharyngitis sicca*. The pillars of the fauces and the uvula are often much relaxed. The secretion forms at the back of the pharynx and the patient may feel it drop down from the vault, or it is tenacious and adherent, and is only removed by repeated efforts at hawking.

In the *treatment* special attention must be paid to the general health. If possible, the cause should be ascertained. The condition is almost constant in smokers, and cannot be cured without stopping the use of tobacco. The use of food either too hot or too much spiced should be forbidden. When it depends upon excessive exercise of the voice, rest should be enjoined. In many of these cases change of air and tonics help very much. In the local treatment of the throat, gargles, washes, and pastilles of various sorts give temporary relief, but when the hypertrophic condition is marked the spots should be thoroughly destroyed by the galvano-cautery. In many instances this affords great and permanent relief, but in others the condition persists, and, as it is not unbearable, the patient gives up all hope of permanent relief.

Ulceration of the Pharynx.—(*a*) *Follicular.*—The ulcers are usually small, superficial, and generally associated with chronic catarrh.

(*b*) *Syphilitic.*—Most frequently painless and situated on the posterior wall of the pharynx, they occur in the secondary stage as small, shallow excavations with the mucous patches. In the tertiary stage they are due to erosion of gummata, and in healing they leave whitish cicatrices.

(*c*) *Tuberculous.*—Not very uncommon in advanced cases of ~~phthisis~~ if

extensive, they form one of the most distressing features of the disease. The ulcers are irregular, with ill-defined edges and grayish-yellow bases. The posterior wall of the pharynx may have an eroded, worm-eaten appearance. These ulcers are, as a rule, intensely painful. Occasionally the primary disease is about the tonsils and the pillars of the fauces.

(*d*) *Ulcers* occur in connection with pseudo-membranous inflammation, particularly the diphtheritic. In cancer and in lupus ulcers are also present.

(*e*) Ulcers are met with in certain of the fevers, particularly in typhoid.

In many instances the diagnosis of the nature of pharyngeal ulcers is very difficult. The tuberculous and cancerous varieties are readily recognized, but it happens not infrequently that a doubt arises as to the syphilitic character of an ulcer. In many instances the local conditions may be uncertain. Then other evidences of syphilis should be sought for, and the patient should be placed on mercury and iodide of potassium, under which remedies specific ulcers usually heal with great rapidity.

Acute Infectious Phlegmon of the Pharynx.—Under this term Senator has described cases in which, along with difficulty in swallowing, soreness of the throat, and sometimes hoarseness, the neck enlarges, the pharyngeal mucosa becomes swollen and injected, the fever is high, the constitutional symptoms are severe, and the inflammation passes on rapidly to suppuration. The symptoms are very intense. The swelling of the pharyngeal tissues early reaches such a grade as to impede respiration. Similar symptoms may be produced by foreign bodies in the pharynx.

Retro-pharyngeal abscess occurs: (*a*) In healthy children between six months and two years of age. The child becomes restless, the voice changes; it becomes nasal or metallic in tone, and there are pain and difficulty in swallowing. Inspection of the pharynx reveals a projecting tumor in the middle line, or, if ~~it be~~ not visible, it is ~~readily~~ felt, on palpation, projecting from the posterior wall. (*b*) As a not infrequent sequel of the fevers, particularly ~~of~~ scarlet fever and diphtheria. (*c*) In caries of the bodies of the cervical vertebræ.

The diagnosis is readily made, as the projecting tumor can be seen, or felt with the finger on the posterior wall of the pharynx.

Angina Ludovici (*Ludwig's Angina; Cellulitis of the Neck*).—In medical practice this is seen as a secondary inflammation in the specific fevers, particularly diphtheria and scarlet fever. It may, however, occur idiopathically or result from trauma. It is probably always a streptococcus infection which spreads rapidly from the glands. The swelling at first is most marked in the submaxillary region of one side. The symptoms are, as a rule, intense, and, unless early and thorough surgical measures are employed, there is great risk of systemic infection. The various acute septic inflammations of the throat —acute œdema of the larynx, phlegmon of the pharynx and larynx, and angina Ludovici—"represent degrees varying in virulence of one and the same process" (Semon). Treatment is surgical, and free incisions should be made.

D. DISEASES OF THE TONSILS

I. SUPPURATIVE TONSILLITIS

Etiology.—Acute suppuration of the tonsillar tissues is met with most frequently in young persons, with chronic enlargement of the glands, sometimes as a sequence of the acute follicular form, already described among the infectious diseases, sometimes as a result of exposure to cold or wet.

Symptoms.—The constitutional disturbance is very great. The temperature rises to 104° or 105° F., and the pulse ranges from 110 to 130. Nocturnal delirium is not uncommon. The prostration may be extreme. There is no local disease of similar extent which so rapidly exhausts the strength of a patient. Soreness and dryness of the throat, with pain in swallowing, are the symptoms of which the patient first complains. One or both tonsils may be involved. They are enlarged, firm to the touch, dusky red and œdematous, and the contiguous parts are also much swollen. The swelling of the glands may be so great that they meet in the middle line, or one tonsil may even push the uvula aside and almost touch the other gland. The salivary and buccal secretions are increased. The glands of the neck enlarge, the lower jaw is fixed, and the patient is unable to open his mouth. In from two to four days the enlarged gland becomes softer, and fluctuation can be distinctly felt by placing one finger on the tonsil and the other at the angle of the jaw. The abscess points usually toward the mouth, but in some cases toward the pharynx. It may burst spontaneously, affording instant and great relief. Suffocation has followed the rupture of a large abscess and the entrance of the pus into the larynx. When the suppuration is peritonsillar and extensive, the internal carotid artery may be opened; but these are, fortunately, very rare accidents.

Occasionally a small focus of deep-seated suppuration is the cause of a fever lasting for weeks or months.

Treatment.—Hot applications in the form of poultices and fomentations are more comfortable and better than the ice-bag. The gland should be felt—it cannot always be seen—from time to time, and should be opened when fluctuation is distinct. The progress of the disease may be shortened and the patient spared several days of great suffering if an incision is made early. The curved bistoury, guarded nearly to the point with plaster or cotton, is the most satisfactory instrument. The incision should be made from above downward, parallel with the anterior pillar. There are cases in which, before suppuration takes place, the parenchymatous swelling is so great that the patient is threatened with suffocation. In such instances either the tonsil must be excised or tracheotomy performed. Delavan refers to two cases in which he states that tracheotomy would, (under these circumstances) have saved life. ? Patients with this affection require a nourishing liquid diet, and during convalescence iron in full doses.

Early removal of the tonsils should be practiced when a child suffers with recurring attacks, and thorough local treatment should be given to the nasopharynx. Particular care should be taken of the child's mouth and throat.

II. CHRONIC TONSILLITIS

(Chronic Naso-pharyngeal Obstruction; Adenoids; Mouth-breathing; Aprosexia)

Under this heading will be considered also hypertrophy of the adenoid tissue in the vault of the pharynx, sometimes known as the pharyngeal tonsil, as the affection usually involves both the tonsils proper and this tissue, and the symptoms are not to be differentiated.

Chronic enlargement of the tissues of the tonsillar ring is an affection of great importance, and may influence in an extraordinary way the mental and bodily development of children.

Etiology.—"Adenoids" have become recognized as one of the most common and important affections of childhood, occurring most frequently between the fifth and tenth years. The introduction of the systematic inspection of school children has done more than anything else to force upon the profession and the public the recognition of the condition as one influencing seriously the bodily and mental growth, disturbing hearing and furnishing a focus for the development of pathogenic organisms. Few children escape altogether. In many it is a trifling affair, easily remedied; in others it is a serious and obstinate trouble, taxing the skill and judgment of the specialist. It is not easy to say why the disease has become so prevalent. In the United States it is attributed to the dry, hot air of the houses, in England to the cold, damp climate. In winter nearly all the school children in England have the "snuffles," and a considerable proportion of them adenoids. Interested in the subject ever since reading Meyer's original paper, I thought American children especially prone, but the disease seems to be even more prevalent in England.

Adenoids may be associated with slight enlargement of the lymph-glands, thymus and spleen in the condition of lymphatism.

Morbid Anatomy.—The tonsils are enlarged, due to multiplication of all the constituents of the glands. The lymphoid elements may be chiefly involved without much development of the stroma. In other instances the fibrous matrix is increased, and the organ is then harder, smaller, firmer, and is cut with much greater difficulty.

The adenoids, which spring from the vault of the pharynx, form masses varying in size from a small pea to an almond. They may be sessile, with broad bases, or pedunculated. They are reddish in color, of moderate firmness, and contain numerous blood-vessels. "Abundant, as a rule, over the vault, on a line with the fossa of the Eustachian tube, the growths may lie posterior to the fossa—namely, in the depression known as the fossa of Rosenmüller, or upon the parts which are parallel to the posterior wall of the pharynx. The growths appear to spring in the main from the mucous membrane covering the localities where the connective tissue fills in the inequalities of the base of the skull" (Harrison Allen). The growths are most frequently papillomatous with a lymphoid parenchyma. Hypertrophy of the pharyngeal adenoid tissue may be present without great enlargement of the tonsils proper. Chronic catarrh of the nose usually coexists.

Symptoms.—The direct effect of adenoids is the establishment of mouth-

breathing. The indirect effects are deformation of the thorax, changes in the facial expression, sometimes marked alteration in the mental condition, in certain cases stunting of the growth, and in a great many subjects deafness. Woods Hutchinson has suggested that the embryological relation of these structures and the pituitary body may account for the interference with development. The establishment of mouth-breathing is the symptom which first attracts the attention. It is not so noticeable by day, although the child may present the vacant expression characteristic of this condition. At night the child's sleep is greatly disturbed; the respirations are loud and snorting, and there are sometimes prolonged pauses, followed by deep, noisy inspirations. The pulse may vary strangely during these attacks, and in the prolonged intervals may be slow, to increase greatly with the forced inspirations. The alæ nasi should be observed during the sleep of the child, as they are sometimes much retracted during inspiration, due to a laxity of the walls, a condition readily remedied by the use of a soft wire dilator. Night terrors are common. The child may wake up in a paroxysm of shortness of breath. Sometimes these attacks are of great severity and the dyspnœa, ~~or rather orthopnœa,~~ may suggest pressure of enlarged glands on the trachea. Sometimes there is a nocturnal paroxysmal cough of a very troublesome character (Balne's cough), usually excited by lying down. The attacks may occur through the day.

When the mouth-breathing has persisted for a long time definite changes are brought about in the face, mouth, and chest. The facies is so peculiar and distinctive that the condition may be evident at a glance. The expression is dull, heavy, and apathetic, due in part to the fact that the mouth is habitually left open. In long-standing cases the child is very stupid-looking, responds slowly to questions, and may be sullen and cross. The lips are thick, the nasal orifices small and pinched-in-looking, the superior dental arch is narrowed and the roof of the mouth considerably raised.

The remarkable alterations in the shape of the chest in connection with enlarged tonsils were first carefully studied by Dupuytren (1828), who evidently fully appreciated the great importance of the condition. He noted "a lateral depression of the parietes of the chest consisting of a depression, more or less great, of the ribs on each side, and a proportionate protrusion of the sternum in front." J. Mason Warren (Medical Examiner, 1839) gave an admirable description of the constitutional symptoms and the thoracic deformities induced by enlarged tonsils. These, with the memoir of Lambron (1861), constitute the most important contributions to our knowledge on the subject. Three types of deformity may be recognized:

(*a*) THE PIGEON OR CHICKEN BREAST, by far the most common form, in which the sternum is prominent and there is a circular depression in the lateral zone (Harrison's groove), corresponding to the attachment of the diaphragm. The ribs are prominent anteriorly and the sternum is angulated forward at the manubrio-gladiolar junction. As a mouth-breather is watched during sleep one can see the lower and lateral thoracic regions retracted during inspiration by the action of the diaphragm.

(*b*) BARREL CHEST.—Some children, the subject of chronic naso-pharyngeal obstruction, have recurring attacks of asthma, and the chest may be gradually deformed, becoming rounded and barrel-shaped, the neck short, and

the shoulders and back bowed. A child of ten or eleven may have the thoracic conformation of an old man with emphysema.

(*c*) The Funnel Breast (*Trichterbrust*).—This remarkable deformity, in which there is a deep depression at the lower sternum, has excited much controversy as to its mode of origin. In some instances, at least, it is due to the obstructed breathing in connection with adenoid vegetations. I have seen two cases in children, in which the condition was in process of formation. During inspiration the lower sternum was forcibly retracted, so much so that at the height the depression corresponded to that of a well-marked "*Trichterbrust.*" While in repose, the lower sternal region was distinctly excavated.

The voice is altered and acquires a nasal quality. The pronunciation of certain letters is changed, and there is inability to pronounce the nasal consonants *n* and *m*. Bloch lays great stress upon the association of mouth-breathing with stuttering.

The hearing is impaired, usually owing to the extension of inflammation along the Eustachian tubes and the obstruction with mucus or the narrowing of their orifices by pressure of the adenoid vegetations. In some instances it may be due to retraction of the drums, as the upper pharynx is insufficiently supplied with air. Naturally the senses of taste and smell are much impaired. With these symptoms there may be little or no nasal catarrh or discharge, but the pharyngeal secretion of mucus is always increased. Children, however, do not notice this, as the mucus is usually swallowed, but older persons expectorate it with difficulty.

Among other symptoms may be mentioned headache, which is by no means uncommon, general listlessness, and an indisposition for physical or mental exertion. Habit-spasm of the face has been described in connection with it. I have known several instances in which permanent relief has been afforded by the removal of the adenoid vegetations. Enuresis is occasionally an associated symptom. The influence upon the mental development is striking. Mouth-breathers are usually dull, stupid, and backward. It is impossible for them to fix the attention for long at a time, and to this impairment of the mental function Guye, of Amsterdam, has given the name *aprosexia*. Headaches, forgetfulness, inability to study without discomfort are frequent symptoms of this condition in students. There is more than a grain of truth in the aphorism *shut your mouth and save your life*, which is found on the title-page of Captain Catlin's celebrated pamphlet on mouth-breathing (1861), to which cause he attributed all the ills of civilization.

A symptom specially associated with enlarged tonsils is fetor of the breath. In the tonsillar crypts the inspissated secretion undergoes decomposition and an odor not unlike that of Limburger cheese is produced. The little cheesy masses may sometimes be squeezed from the crypts of the tonsils. Though the odor may not apparently be very strong, yet if the mass be squeezed between the fingers its intensity will at once be appreciated. In some cases of chronic enlargement the cheesy masses may be deep in the tonsillar crypts; and if they remain for a prolonged period lime salts are deposited and a tonsillar calculus is in this way produced.

Children with adenoids are especially prone to take cold and to recurring attacks of follicular disease. They are also more liable to diphtheria, and in them the anginal features in scarlet fever are always more serious. The ulti-

mate results of untreated adenoid hypertrophy are important. In some cases the vegetations disappear, leaving an atrophic condition of the vault of the pharynx. Neglect may also lead to the so-called Thornwaldt's disease, in which there is a cystic condition of the pharyngeal tonsil and constant secretion of muco-pus.

Diagnosis.—The facial aspect is usually distinctive. Enlarged tonsils are readily seen on inspection of the pharynx. There may be no great enlargement of the tonsils and nothing apparent at the back of the throat even when the naso-pharynx is completely blocked with adenoid vegetations. In children the rhinoscopic examination is rarely practicable. Digital examination is the most satisfactory. The growths can then be felt either as small, flat bodies or, if extensive, as velvety, grape-like papillomata.

Treatment.—If the tonsils are large and the general state is evidently influenced by them they should be at once removed. Applications of iodine and iron, or penciling the crypts with nitrate of silver, are of service in the milder grades, but it is waste of time to apply them to very enlarged glands. There is a condition in which the tonsils are not much enlarged, but the crypts are constantly filled with cheesy secretions and cause a very bad odor in the breath. In such instances the removal of the secretion and thorough penciling of the crypts with chromic acid may be practiced. The galvano-cautery is of great service in many cases of enlarged tonsils when there is any objection to the more radical surgical procedure.

The treatment of the adenoid growths in the pharynx is of the greatest importance, and should be thoroughly carried out. Parents should be frankly told that the affection is serious, one which impairs the mental not less than the bodily development of the child. In spite of the thorough ventilation of this subject by specialists, practitioners do not appear to have grasped as yet the full importance of this disease. They are far too apt to temporize and unnecessarily to postpone radical measures. The child must be anæsthetized. Severe hæmorrhage has followed in a few cases. Special examination should be made of the thymus and lymph glands, as if they are enlarged the operation should be postponed. In this state of lymphatism death during anæsthesia has occurred. The good effects of the operation are often apparent within a few days, and the child begins to breathe through the nose. In some instances the habit of mouth-breathing persists. As soon as the child goes to sleep the lower jaw drops and the air is drawn into the mouth. In these cases a chin strap can be readily adjusted, which the child may wear at night. In severe cases it may take months of careful training before the child can speak properly. An all-important point in the treatment of lesions of the naso-pharynx (and, indeed, in the prevention of this unfortunate condition) is to increase the breathing capacity of the chest by making the child perform systematic exercises, which cause the air to be driven freely and forcibly in and out through the naso-pharynx. I cannot too strongly commend this suggestion of Mr. Arbuthnot Lane.

Throughout the entire treatment attention should be paid to hygiene and diet, and cod-liver oil and the iodide of iron may be administered with benefit.

E. DISEASES OF THE ŒSOPHAGUS

I. ACUTE ŒSOPHAGITIS

Etiology.—Acute inflammation occurs (*a*) in the catarrhal processes of the specific fevers; more rarely as an extension from catarrh of the pharynx. (*b*) As a result of intense mechanical or chemical irritation, produced by foreign bodies, by very hot liquids, or by strong corrosives. (*c*) In the form of pseudo-membranous inflammation in diphtheria, and occasionally in pneumonia, typhoid fever, and pyæmia. (*d*) As a pustular inflammation in small-pox, and, according to Laennec, as a result of a prolonged administration of tartar emetic. (*e*) In connection with local disease, particularly cancer either of the tube itself or extension to it from without. And, lastly, acute œsophagitis, occasionally with ulceration, may occur spontaneously in sucklings.

Morbid Anatomy.—It is extremely rare to see redness of the mucosa, except when chemical irritants have been swallowed. More commonly the epithelium is thickened and has desquamated, so that the surface is covered with a fine granular substance. The mucous follicles are swollen and occasionally there ~~may be seen~~ are small erosions. In the pseudo-membranous inflammation there is a grayish ~~croupous~~ exudate, usually limited in extent, at the upper portion of the gullet. The pustular disease is very rare in small-pox. In the phlegmonous inflammation the mucous membrane is greatly swollen, and there is purulent infiltration in the submucosa. It may ~~even~~ extend throughout a large part of the gullet. Gangrene occasionally supervenes. There is a remarkable fibrinous or membranous œsophagitis, most frequently met with in the fevers, sometimes also in hysteria, in which long casts of the tube may be vomited.

Symptoms.—Pain in deglutition is always present in severe inflammation of the œsophagus. A dull pain beneath the sternum is also present. In the milder forms of catarrhal inflammation there are usually no symptoms. The presence of a foreign body is indicated by dysphagia and spasm with the regurgitation of portions of the food. Later, blood and pus may be ejected. It is surprising how extensive the disease may be in the œsophagus without producing much pain or great discomfort, except in swallowing. The intense inflammation which follows the swallowing of corrosives, when not fatal, gradually subsides, and often leads to cicatricial contraction and stricture. In the cases in which there is danger of contraction œsophageal bougies should be passed before this is marked. The patient should swallow some oil before the passage of the bougie, the size of which should be gradually increased. Dilatation should be done every few days at first.

Treatment.—The treatment of acute inflammation of the œsophagus is extremely unsatisfactory, particularly in the severer forms. The slight catarrhal cases require no special treatment. When the dysphagia is intense it is best not to give food by the mouth, but to feed entirely by enemata. Fragments of ice may be given, and as the pain and distress subside, demulcent drinks. External applications of cold often give relief.

A *chronic* form of œsophagitis is described, but this results usually from the prolonged action of the causes which produce the acute form.

Catarrhal Ulceration.—Follicular ulcers are not uncommon. Tuberculous and syphilitic ulcers are rare. Very prominent varicose veins and small erosions are not uncommon. The other forms are the carcinomatous, the erosion due to aneurism, and the ulcerative action of corrosive substances. There are two other important varieties—the ulcers in acute infectious diseases, diphtheria, scarlet fever, and pneumonia; and the peptic ulcer, first described by Albers in 1839. Tileston has collected forty cases of peptic ulcer in the œsophagus. The pain, dysphagia, vomiting, and hæmorrhage have been the most important symptoms. Perforation occurred in six cases, in one instance into the aorta. Treatment is difficult; in severe cases gastrostomy should be done.

Œsophageal Varices.—Associated with chronic heart-disease and more frequently with the senile and the cirrhotic liver, the œsophageal veins may become distended and varicose. The mucous membrane is in a state of chronic catarrh, and the patient has frequent eructations of mucus. Rupture of these varices is one of the commonest causes of hæmatemesis in cirrhosis of the liver and in enlarged spleen. The blood may pass per rectum alone.

II. SPASM OF THE ŒSOPHAGUS

(*Œsophagismus*)

This so-called spasmodic stricture of the gullet is met with in hysterical patients and hypochrondriacs, also in chorea, epilepsy, and especially hydrophobia. It is sometimes associated also with the lodgment of foreign bodies, or with cases in which a patient has swallowed a foreign body and thinks it has stuck. For weeks there may be spasm, due perhaps to autosuggestion, though the bougie passes freely. The idiopathic form is found in females of a marked neurotic habit, but may also occur in elderly men. It may be present only during pregnancy. The patient complains of inability to swallow solid food, and in extreme instances even liquids are rejected. The attack may come on abruptly, and be associated with emotional disturbances and with substernal pain. The bougie, when passed, may be arrested temporarily at the seat of the spasm, which gradually yields, or it may slip through without the slightest effort. The condition is rarely serious, though it may persist for years. Spasm of the lower end of the gullet, associated with cardio-spasm, may be the cause of a remarkable fusiform dilatation of the œsophagus.

The *diagnosis* is not difficult, particularly in young persons with marked nervous manifestations. In elderly persons œsophagismus ~~is almost always connected~~ with hypochondriasis, but great care must be taken to exclude cancer.

In some cases a cure is at once effected by the passage of a bougie. The general neurotic condition also requires special attention.

Paralysis of the œsophagus scarcely demands separate consideration. It is a very rare condition, due most often to central disease, particularly bulbar paralysis. It may be peripheral in origin, as in diphtheritic paralysis. Occasionally it occurs also in hysteria. The essential symptom is dysphagia.

III. STRICTURE OF THE ŒSOPHAGUS

This results from: (*a*) Congenital stenosis of the œsophagus.—There are two groups of cases, one in which there is complete occlusion, and the middle of the tube is converted into a fibrous cord; the other, the more common, in which the lower part opens into the trachea or one of the bronchi. There are some 19 cases on record (William Thomas). (*b*) The cicatricial contraction of healed ulcers, usually due to corrosive poisons, occasionally to syphilis, and in rare instances after the fevers. (*c*) The growth of tumors in the walls, as in the so-called cancerous stricture. Eighty-five per cent. of the cases are of this nature. (*d*) External pressure by aneurism, enlarged lymph-glands, enlarged thyroid, other tumors, and sometimes by pericardial effusion.

The cicatricial stricture may occur anywhere in the gullet, and in extreme cases may, indeed, involve the whole tube, but in a majority of instances it is found either high up near the pharynx or low down toward the stomach. The narrowing may be extreme, so that only small quantities of food can trickle through, or the obstruction may be quite slight. When the stricture is low down the œsophagus is dilated and the walls are usually much hypertrophied. When the obstruction is high in the gullet, the food is usually rejected at once, whereas, if it is low, it may be retained and a considerable quantity collects before it is regurgitated. Any doubt as to its having reached the stomach is removed by the alkalinity of the material ejected and the absence of the characteristic gastric odor. Auscultation of the œsophagus may be practiced and is sometimes of service. The patient takes a mouthful of water and the auscultator listens along the left of the spine. The normal œsophageal *bruit* may be heard later than seven seconds, the normal time, or there may be heard a loud splashing, gurgling sound. The secondary murmur, heard as the fluid enters the stomach, may be absent. The bismuth meal and the fluoroscope now make the diagnosis very easy. The passage of the œsophageal bougie will determine accurately the locality. Conical bougies attached to a flexible whalebone stem are the most satisfactory, but the gum-elastic stomach tube may be used; a large one should be tried first. The patient should be placed on a low chair with the head well thrown back. The index finger of the left hand is passed far into the pharynx, and in some instances this procedure alone may determine the presence of a new growth. The bougie is passed beside the finger until it touches the posterior wall of the pharynx, then along it, more to one side than in the middle line, and so gradually pushed into the gullet. It is to be borne in mind that in passing the cricoid cartilage there is often a slight obstruction. Great gentleness should be used, as it has happened more than once that the bougie has been passed through a cancerous ulcer into the mediastinum or through a diverticulum. It is well always, as a precautionary measure before passing the bougie, to examine carefully for aneurism, which may produce all the symptoms of organic stricture. In cases in which the narrowing is extreme there is always emaciation. For treatment, surgical works must be consulted.

IV. CANCER OF THE ŒSOPHAGUS

This is usually epithelioma. It is not a common disease; there were only 38 cases in the medical wards of the Johns Hopkins Hospital in twenty-three years. It may occur in quite young persons, and is more frequent in males than in females. The middle and lower thirds are most often affected. At first confined to the mucous membrane, the cancer gradually increases and soon ulcerates. The lumen of the tube is narrowed, but when ulceration is extensive in the later stages the stricture may be less marked. Dilatation of the tube and hypertrophy of the walls usually take place above the cancer. The ulcer may perforate the trachea or a bronchus, the lung, the pleura, the mediastinum, the aorta or one of its larger branches, the pericardium, or it may erode the vertebral column. The recurrent laryngeal nerves are not infrequently implicated. Perforation of the lung produces, as a rule, local gangrene.

Symptoms.—The earliest symptom is dysphagia, which is progressive and may become extreme, so that the patient emaciates rapidly. Regurgitation may take place at once; or, if the cancer is situated near the stomach, it may be deferred for ten or fifteen minutes, or even longer if the tube is much dilated. The rejected materials may be mixed with blood and may contain cancerous fragments. In persons over fifty years of age persistent difficulty in swallowing accompanied by rapid emaciation usually indicates œsophageal cancer. The cervical lymph-glands are frequently enlarged and may give early indication of the nature of the trouble. Pain may be persistent or be present only when food is taken. In certain instances the pain is very great. The latent cases are very rare. Bronchitis and broncho-pneumonia are common terminal events.

Diagnosis.—The bismuth meal and the Röntgen-ray picture give information as to the position of the stricture, and a very dense growth may throw a shadow. In the diagnosis of the condition it is important, in the first place, to exclude pressure from without, as by aneurism or other tumor. The history enables us to exclude cicatricial stricture and foreign bodies. The sound may be passed and the presence of the stricture determined. As mentioned above, great care should be exercised. Fragments of carcinomatous tissue may in some instances be removed with the tube. On auscultation along the left side of the spine the primary œsophageal murmur may be much altered in quality.

Treatment.—In most cases milk and liquids can be swallowed, but supplementary nourishment should be given by the rectum. It may be advisable in some instances to pass a tube into the stomach and introduce food in this way. When there is difficulty in feeding the patient it is very much better to have gastrostomy performed at once, as it gives the greatest comfort and ease, and prolongs the patient's life.

V. RUPTURE OF THE ŒSOPHAGUS

(*a*) Rupture may occur in a healthy organ as a result of prolonged vomiting after a full meal, or when intoxicated. Eight cases are on record (Vir-

chow's Archiv, vol. 162). Boerhaave described the first case in Baron Wassenaar, who "broke asunder the tube of the œsophagus near the diaphragm, so that, after the most excruciating pain, the elements which he swallowed passed, together with the air, into the cavity of the thorax, and he expired in twenty-four hours."

(*b*) In a few cases the rupture has occurred in a diseased and weakened tube, near the scar of an ulcer, for example.

(*c*) Post mortem softening—œsophago-malacia—a not very uncommon condition, must not be mistaken for it. In spontaneous rupture the rent is clean-cut and circumferential; in malacia it is rounded and often cribriform, and the margins are softened. The contents of the stomach may be in the left pleura.

VI. DILATATIONS AND DIVERTICULA

Stenosis of the gullet is followed by secondary dilatation of the tube above the constriction and great hypertrophy of the walls. Primary dilatation, which is extremely rare, appears to be associated with spasm of the lower end of the gullet and of the cardiac orifice. The tube may attain extraordinary dimensions, as in the specimen presented in 1904 to the Association of American Physicians by Kinnicutt. Regurgitation of food is the most common symptom. There may also be difficulty in breathing from pressure.

Diverticula are of two forms: (*a*) Pressure diverticula, which are most common at the junction of the pharynx and gullet, on the posterior wall. Owing to weakness of the muscles at this spot, local bulging occurs, which is gradually increased by the pressure of food, and finally forms a saccular pouch. (*b*) The traction diverticula situated on the anterior wall near the bifurcation of the trachea result, as a rule, from the extension of inflammation from the lymph-glands with adhesion and subsequent cicatricial contraction, by which the wall of the gullet is drawn out. The diagnosis of these forms is now readily made with the bismuth meal and X-rays. Diverticula have been successfully extirpated.

A rare and remarkable condition, of which a case has been recorded by MacLachlan, and of which a second was in attendance at my clinic, is the œsophago-pleuro-cutaneous fistula. In my patient fluids were discharged at intervals through a fistula in the right infra-clavicular region, which communicated with a cavity in the upper part of the pleura or lung. The condition had persisted for more than twenty-five years.

F. DISEASES OF THE STOMACH

I. ACUTE GASTRITIS

(*Simple Gastritis; Acute Gastric Catarrh; Acute Dyspepsia*)

Etiology.—Acute gastric catarrh, one of the most common of complaints, occurs at all ages, and is usually traceable to errors in diet. It may follow

Uniform dilatation of stom. may be result of a contracted stomach. This
may be due to syphilis or scirrhous cancer of whole stomach.

the ingestion of more food than the stomach can digest, or it may result from taking unsuitable articles, which either themselves irritate the mucosa or, remaining undigested, decompose, and so excite an acute dyspepsia. A frequent cause is the taking of food which has begun to decompose, particularly in hot weather. In children these fermentative processes are very apt to excite acute catarrh of the bowels as well. Another very common cause is the abuse of alcohol, and the acute gastritis which follows a drinking-bout is one of the most typical forms of the disease. The tendency to acute indigestion varies very much in different individuals, and, indeed, in families. We recognize this in using the expressions a "delicate stomach" and a "strong stomach." Gouty persons are generally thought to be more disposed to acute dyspepsia than others. Acute catarrh of the stomach occurs at the outset of many of the infectious fevers.

Morbid Anatomy.— Beaumont's study of St. Martin's stomach showed that in acute catarrh the mucous membrane is reddened and swollen, less gastric juice is secreted, and mucus covers the surface. Slight hæmorrhages may occur or even small erosions. The submucosa may be somewhat œdematous. Microscopically the changes are chiefly noticeable in the mucous and peptic cells, which are swollen and more granular, and there is an infiltration of the intertubular tissue with leucocytes.

Symptoms.—In mild cases the symptoms are those of slight "indigestion" —an uncomfortable feeling in the abdomen, headache, depression, nausea, eructations, and vomiting, which usually gives relief. The tongue is heavily coated and the saliva is increased. In children there are intestinal symptoms —diarrhœa and colicky pains and often slight fever. The duration is rarely more than twenty-four hours. In the severer forms the attack may set in with a chill and febrile reaction, in which the temperature rises to 102° or 103° F. The tongue is furred, the breath heavy, and vomiting is frequent. The ejected substances, at first mixed with food, subsequently contain much mucus and bile-stained fluids. There may be constipation, but very often there is diarrhœa. The urine presents the usual febrile characteristics, and there is a heavy deposit of urates. The abdomen may be somewhat distended and slightly tender in the epigastric region. Herpes may appear on the lips. The attack may last from one to three days, and occasionally longer. The examination of the vomitus shows, as a rule, absence of hydrochloric acid, the presence of lactic and fatty acids, and marked increase in the mucus.

Diagnosis.—The ordinary afebrile gastric catarrh is readily recognized. The acute febrile form is so similar to the initial symptoms of many of the infectious diseases that it is impossible for a day or two to make a diagnosis, particularly in the cases which have come on, so to speak, spontaneously and independently of an error in diet. Some of these resemble closely an acute infection; the symptoms may be very intense, and if, as sometimes happens, the attack sets in with severe headache and delirium, the case may be mistaken for meningitis. When the abdominal pains are intense the attack may be confounded with gallstone colic. It is a very common error to class under "gastric fever" the mild forms of the various infectious disorders. The gastric crises in locomotor ataxia have in many instances been confounded with a simple acute gastritis, and it is always wise in adults to test the knee-jerks and pupillary reactions.

Treatment.—Mild cases recover spontaneously in twenty-four hours, and require no treatment other than a dose of castor oil in children or of blue mass in adults. In the severer forms, if there is much distress in the region of the stomach, the vomiting should be promoted by warm water, or the stomach tube may be employed for some patients. A dose of calomel, 2 to 3 grains (0.13 to 0.2 gm.), should be given, and followed, after some hours, by a saline cathartic. If there is eructation of acid fluid, bicarbonate of soda and bismuth may be given. The stomach should have, if possible, absolute rest, and it is a good plan in the case of strong persons, particularly in those addicted to alcohol, to cut off all food for a day or two. The patient may be allowed soda water and ice freely. It is well not to attempt to check the vomiting unless it is excessive and protracted. Recovery is usually complete, though repeated attacks may lead to subacute gastritis, ~~or to the establishment of chronic dyspepsia~~.

Phlegmonous Gastritis; Acute Suppurative Gastritis.—The disease is due to infection of the submucosa, probably through a minute abrasion. Males are more frequently affected than females, and most of the cases are in comparatively young people. In a majority of the instances in which the examination has been made streptococci have been present, but the pneumococcus has been found in a few cases. The disease is rare; Leith was able to collect only 85 cases. There is a widespread suppurative infiltration of the submucosa, with great thickening of the walls. Sometimes there is a localized abscess formation, with tumor, which may burst into the stomach, or into the peritoneum. I have seen three instances of this condition, all in connection with cancer of the stomach.

The important symptoms are pain, high fever, vomiting, dry tongue, all the features of a severe infection, and sometimes jaundice. A diagnosis is rarely made; occasionally there is a large tumor mass to be felt. The cases are uniformly fatal unless one counts the one reported by Bovee, in which he cut down and opened an acute abscess, the size of a man's fist, in the anterior wall of the pyloric region.

Toxic Gastritis.—This most intense form of inflammation of the stomach is excited by the swallowing of concentrated mineral acids or strong alkalies, or by such poisons as phosphorus, corrosive sublimate, ammonia, arsenic, etc. In the non-corrosive poisons, such as phosphorus, arsenic, and antimony, the process consists of an acute degeneration of the glandular elements, and hæmorrhage. With the powerful concentrated poisons the mucous membrane is extensively destroyed, and may be converted into a brownish-black eschar. In the less severe grades there may be areas of necrosis surrounded by inflammatory reaction, while the submucosa is hæmorrhagic and infiltrated. The process is of course more intense at the fundus, but the active peristalsis may drive the poison through the pylorus into the intestine.

Symptoms.—The symptoms are intense pain in the mouth, throat, and stomach, salivation, great difficulty in swallowing, and constant vomiting, the vomited materials being bloody and sometimes containing portions of the mucous membrane. The abdomen is tender, distended, and painful on pressure. In the most acute cases symptoms of collapse supervene; the pulse is weak, the skin pale and covered with sweat; there is restlessness, and sometimes convulsions. There may be albumin or blood in the urine, and petechiæ

orchonic

may occur on the skin. When the poison is less intense, the sloughs may separate, leaving ulcers, which too often lead, in the œsophagus to stricture, in the stomach to chronic atrophy, and finally to death from exhaustion.

Diagnosis.—The diagnosis of toxic gastritis is usually easy, as inspection of the mouth and pharynx shows, in many instances, corrosive effects, while the examination of the vomit may indicate the nature of the poison.

In poisoning by acids, magnesia should be administered in milk or with egg albumen. When strong alkalies have been taken, the dilute acids should be administered. If the case is seen early, lavage should be used. For the severe inflammation which follows the swallowing of the stronger poisons palliative treatment is alone available, and morphia may be freely employed to allay the pain.

Diphtheritic or Membranous Gastritis.—This ~~condition~~ is met with occasionally in diphtheria, but more commonly as a secondary process in typhus or typhoid fever, pneumonia, pyæmia, small-pox, and occasionally in debilitated children. The exudation may be extensive and uniform or in patches. The condition is not recognizable during life, unless the membranes are vomited.

Mycotic and Parasitic Gastritis.—It occasionally happens that fungi grow in the stomach and excite inflammation. One of the most remarkable cases of the kind is that reported by Kundrat, in which the favus fungus occurred in the stomach and intestine.

In cancer and in dilatation of the stomach the sarcinæ and yeast fungi probably aid in maintaining the chronic gastritis. As a rule, the gastric juice is capable of killing the ordinary bacteria. Orth states that the anthrax bacilli, in certain cases, produce swelling of the mucosa and ulceration. Eug. Fraenkel has reported a case of acute emphysematous gastritis probably of mycotic origin. The larvæ of certain insects may excite gastritis, as in the cases reported by Gerhardt, Meschede, and others.

II. CHRONIC GASTRITIS

(Chronic Catarrh of the Stomach; Chronic Dyspepsia)

Definition.—A condition of disturbed digestion associated with increased mucous formation, qualitative or quantitative changes in the gastric juice, enfeeblement of the muscular coats, so that the food is retained for an abnormal time in the stomach; and, finally, with alterations in the structure of the mucosa.

Etiology.—The causes of chronic gastritis may be classified as follows: (*a*) *Dietetic.* Unsuitable or improperly prepared food, and the persistent use of certain articles of diet, such as very fat substances or foods containing too much of the carbohydrates. The use in excessive quantity of hot bread, hot cakes, and pie is a fruitful cause, particularly in the United States. The use in excess of tea or coffee, and, above all, of alcohol in its various forms. Under this heading, too, may be mentioned the habits of eating at irregular hours or too rapidly and imperfectly chewing the food. Excess in eating does more damage than excess in drinking. The platter kills more than the

sword. A common cause of chronic catarrh is drinking too freely of ice-water during meals, a practice which plays no small part in the prevalence of dyspepsia in America. Another frequent cause is the abuse of tobacco, particularly chewing. (*b*) *Constitutional causes.* Anæmia, chlorosis, chronic tuberculosis, gout, diabetes, and Bright's disease are often associated with chronic gastric catarrh. (*c*) *Local conditions:* (1) of the stomach, as in cancer, ulcer, and dilatation, which are invariably accompanied by catarrh; (2) conditions of the portal circulation, causing chronic engorgement of the mucous membrane, as in cirrhosis, chronic heart-disease, and certain chronic lung affections.

Morbid Anatomy.—In simple chronic gastritis the organ is usually enlarged, the mucous membrane pale gray in color, and covered with closely adherent, tenacious mucus. The veins are large, patches of ecchymosis are not infrequently seen, and in the chronic catarrh of portal obstruction and of chronic heart-disease small hæmorrhagic erosions. Toward the pylorus the mucosa is not infrequently irregularly pigmented, and presents a rough, wrinkled, mammilated surface, the *état mameloné* of the French, a condition which may sometimes be so prominent that writers have described it as *gastritis polyposa.* The membrane may be thinner than normal, and much firmer, tearing less readily with the finger-nail. The minute anatomy shows the picture of a parenchymatous and an interstitial inflammation. The mucous membrane may undergo complete atrophy and be represented by a smooth cuticular membrane resembling that of the cardiac portion of the horse's stomach. This was the condition in a case of profound anæmia reported by F. P. Henry and myself. The mucularis mucosa was hypertrophied, but with no great general thickening of the stomach walls.

Symptoms.—The affection persists for an indefinite period, and, as is the case with most chronic diseases, changes from time to time. The appetite is variable, sometimes greatly impaired, at others very good. Among early symptoms are feelings of distress or oppression after eating, which may become aggravated and amount to actual pain. When the stomach is empty there may also be a painful feeling. The pain differs in different cases, and may be trifling or of extreme severity. When localized and felt beneath the sternum or in the præcordial region it is known as heart-burn or sometimes cardialgia. There is pain on pressure over the stomach, usually diffuse and not severe. The tongue is coated, and the patient complains of a bad taste in the mouth. The tip and margin of the tongue are very often red. Associated with this catarrhal stomatitis there may be an increase in the salivary and pharyngeal secretions. Nausea is an early symptom, and is particularly apt to occur in the morning hours. It is not, however, nearly so constant a symptom in chronic gastritis as in cancer of the stomach, and in mild grades of the affection it may not occur at all. Eructation of gas, which may continue for some hours after taking food, is a very prominent feature in cases of so-called flatulent dyspepsia, and there may be marked distention of the intestines. With the gas, bitter fluids may be brought up. Vomiting, which is not very frequent, occurs either immediately after eating or an hour or two later. In the chronic catarrh of old topers a bout of morning vomiting is common, in which a slimy mucus is brought up. The vomitus consists of food in various stages of digestion and slimy mucus, and the chemical examination

shows the presence of abnormal acids, such as butyric, or even acetic, in addition to lactic acid, while the hydrochloric acid, if present, is much reduced in quantity. The digestion may be much delayed, and, on washing out the stomach as late as seven hours after eating, portions of food are still present. The prolonged retention favors decomposition, the stomach becomes distended with gas, and this, with the chronic catarrh, may induce gradually an atony of the muscular walls, but the motor function of the stomach is not usually much impaired. The absorption is slow, and iodide of potassium, given in capsules, which should normally reach the saliva within fifteen minutes, may not be evident for more than half an hour.

Constipation is usually present, but in some instances there is diarrhœa, and undigested food passes rapidly through the bowels. The urine is often scanty, high-colored, and deposits a heavy sediment of urates.

Of other symptoms headache is common, and the patient feels constantly out of sorts, indisposed for exertion, and low-spirited. In aggravated cases melancholia may occur. Trousseau called attention to the occurrence of vertigo, a marked feature in certain cases. The pulse is small, sometimes slow, and there may be palpitation of the heart. Fever does not occur. Cough is sometimes present, but the so-called stomach cough of chronic dyspeptics is in all probability dependent upon pharyngeal irritation. J. T. Pilcher has called attention to the frequency with which absence of free hydrochloric acid is found with the presence of occult blood in chronic gastritis. In very many of these the stomach condition appears to be secondary to local disease elsewhere in the abdomen, particularly the appendix, gall-bladder or the pancreas. The bleeding comes from small erosions, and is always of the so-called occult variety. Many varieties of pathogenic organisms are almost constantly found, of which the streptococci are the most important.

The Gastric Contents.—The fasting stomach may be empty or it may contain much mucus—*gastritis mucipara* of Boas. In the test breakfast, withdrawn in an hour, the HCl is usually diminished, though it may be normal—*gastritis acida.* In other cases the free HCl may be absent—*gastritis anacida.* While in the advanced forms of atrophy of the mucosa there may be neither acids nor ferments—*gastritis atrophicans.*

The symptoms of atrophy of the mucous membrane of the stomach, without contraction of the organ, are very complex, and cannot be said to present a uniform picture. The majority of the cases present the symptoms of an aggravated chronic dyspepsia, often of such severity that cancer is suspected. In one of the cases which I examined the persistent distress after eating, the vomiting, and the gradual loss of flesh and strength very naturally led to this diagnosis, but the duration of the disease far exceeded that of ordinary carcinoma. The clinical picture may be that of a severe anæmia. As early as 1860 Flint called attention to this connection between atrophy of the gastric tubules and anæmia, an observation which Fenwick and others have amply confirmed.

Diagnosis.—Ewald distinguishes three forms of chronic gastritis: (1) Simple gastritis; (2) mucous (*schleimige*) gastritis; (3) atrophic gastritis.

In (1) the fasting stomach contains only a small quantity of a slimy fluid, while after the test breakfast the HCl is diminished in quantity or may be absent. Lactic acid and the fatty acids may be present. After Boas's

more rigid test meal the organic acids are rarely found. The pepsin and rennin are always present.

In (2) the acidity is always slight and the condition is distinguished from (1) chiefly by the large amount of mucus present.

In (3) the fasting stomach is generally empty, while after the test breakfast HCl, pepsin, and rennin are wholly wanting.

The diagnosis of cancer of the stomach from chronic gastritis may be very difficult when a tumor is not present. The cases require most careful study, and it is important to decide whether the stomach is primarily at fault, or whether the chronic gastritis is associated with disease of the other organs—liver, gall-bladder, appendix or pancreas.

Treatment.—When possible the cause in each case should be ascertained and an attempt made to determine the special form of indigestion. Usually there is no difficulty in differentiating the ordinary catarrhal and the nervous varieties. A careful study of the phenomena of digestion, though not essential in every instance, should certainly be carried out in the more obstinate and obscure forms. Two important questions should be asked of every dyspeptic—first, as to the time taken at his meals; and, second, as to the quantity he eats. Practically a large majority of all cases of disturbed digestion come from hasty and imperfect mastication of the food and from overeating. Especial stress should be laid upon the former point. In some instances it will alone suffice to cure dyspepsia if the patient will count a certain number before swallowing each mouthful. The second point is of even greater importance. People habitually eat too much, and it is probably true that a greater number of maladies arise from excess in eating than from excess in drinking. Chittenden's researches have shown that we require much less nitrogenous food to maintain a standard of perfect health—a lesson that the Hindoos and Japanese have also taught us. George Cheyne's thirteenth aphorism, already quoted under the section on Obesity, contains a volume of dietetic wisdom.

(*a*) General and Dietetic.—A careful and systematically arranged dietary is the first, sometimes the only, essential in the treatment of a case of chronic dyspepsia. It is impossible to lay down rules applicable to all cases. Individuals differ extraordinarily in their capability of digesting different articles of food, and there is much truth in the old adage, "One man's food is another man's poison." The individual preferences for different articles of food should be permitted in the milder forms. Physicians have probably been too arbitrary in this direction, and have not yielded sufficiently to the intimations given by the appetite and desires of the patient.

A rigid milk diet may be tried. "Milk and sweet sound Blood differ in nothing but in Color: *Milk* is *Blood*" (George Cheyne). In the forms associated with Bright's disease and chronic portal congestion, as well as in many instances in which the dyspepsia is part of a neurasthenic or hysterical trouble, this plan in conjunction with rest is most efficacious. If milk is not digested well it may be diluted one-third with soda water or Vichy, or 5 to 10 grains of carbonate of soda, or a pinch of salt may be added to each tumblerful. In many cases the milk from which the cream has been taken is better borne. Buttermilk is particularly suitable, but can rarely be taken for so long a time alone, as patients tire of it much more readily than they do of ordinary

milk. Not only can the general nutrition be maintained on this diet, but patients sometimes increase in weight, and the unpleasant gastric symptoms disappear entirely. It should be given at fixed hours and in definite quantities. A patient may take 6 or 8 ounces every three hours. The amount necessary varies a good deal, but at least 3 to 5 pints should be given in the twenty-four hours. This form of diet is not, as a rule, well borne when there is a tendency to dilatation of the stomach. The milk may be previously peptonized, but it is impossible to feed a chronic dyspeptic in this way. The stools should be carefully watched, and if more milk is taken than can be digested it is well to supplement the diet with eggs and dry toast or biscuits.

In a large proportion of the cases of chronic indigestion it is not necessary to annoy the patient with such strict dietaries. It may be quite sufficient to cut off certain articles of food. Thus, if there are acid eructations or flatulency the farinaceous foods should be restricted, particularly potatoes and the coarser vegetables. A fruitful source of indigestion is the hot bread which, in different forms, is regarded as an essential part of an American breakfast. This, as well as the various forms of pancakes, pies and tarts, with heavy pastry, and fried articles of all sorts, should be strictly forbidden. As a rule, white bread, toasted, is more readily digested than bread made from the whole meal. Persons, however, differ very much in this respect, and the Graham or brown bread is most digestible for many people. Sugar and very sweet articles of food should be taken in great moderation or avoided altogether by persons with chronic dyspepsia. Many instances of aggravated indigestion have come to my notice due to the prevalent practice of eating largely of ice-cream. One of the most powerful enemies of the American stomach in the present day is the soda-water fountain, which has usurped so important a place in the apothecary shop.

Fats, with the exception of a moderate amount of good butter, very fat meats, and thick, greasy soups should be avoided. Ripe fruit in moderation is often advantageous, particularly when cooked. Bananas are not, as a rule, well borne. Strawberries are to many persons a cause of an annual attack of indigestion and sore throat.

As stated, in the matter of special articles of food it is impossible to lay down rigid rules, and it is the common experience that one patient with indigestion will take with impunity the very articles which cause the greatest distress to another.

Another detail of importance which may be mentioned in this connection is the general hygienic management of dyspeptics. These patients are often introspective, dwelling in a morbid manner on their symptoms, and much inclined to take a despondent view of their condition. Very little progress can be made unless the physician gains their confidence from the outset. Their fears and whims should not be made too light of or ridiculed. Systematic exercise, carefully regulated, particularly when, as at watering places, it is combined with a restricted diet, is of special service. Change of air and occupation, a prolonged sea voyage, or a summer in the mountains will sometimes cure the most obstinate dyspepsia.

(*b*) Medicinal.—The special therapeutic measures may be divided into those which attempt to replace in the digestive juices important elements which are lacking and those which stimulate the weakened action of the organ

In the first group come the hydrochloric acid and ferments, which are so freely employed in dyspepsia. The former is the most important. It is the ingredient in the gastric juice most commonly deficient. It is not only necessary for its own important actions, but its presence is intimately associated with that of the pepsin, as it is only in the presence of a sufficient quantity that the pepsinogen is converted into the active digestive ferment. It is best given as the dilute acid taken in somewhat larger quantities than are usually advised. Ewald recommends large doses—of from 90 to 100 drops—at intervals of fifteen minutes after the meals. Leube and Riegel advise smaller doses. Probably from 15 to 20 drops is sufficient. The prolonged use of it does not appear to be in any way hurtful. The use, however, should be restricted to cases of neurosis and atrophy of the mucous membrane. In actual gastritis its value is doubtful.

Nitrate of silver is a good remedy in some cases, used in solution in the lavage (1 to 1,500 or 1 to 2,000), or in pill form, one-eighth to one-fourth of a grain three times a day. For many years Pepper advocated the more extended use of this drug in chronic gastritis. I have seen an instance of argyria after its protracted use.

The digestive ferments are extensively employed to strengthen the weakened gastric and intestinal secretions. The use of pepsin, according to Ewald, may be limited to the cases of advanced mucous catarrh and the instances of atrophy of the stomach, in which it should be given, in doses of from 10 to 15 grains, with dilute hydrochloric acid a quarter of an hour after meals. Pancreatin is of equal or even greater value than pepsin, but pains should be taken to use a good article. It should be given in doses of from 15 to 20 grains, in combination with bicarbonate of soda. It is conveniently administered in tablets, each of which contains 5 grains of the pancreatin and the soda, and of these two or three may be taken fifteen or twenty minutes after each meal. Ptyalin and diatase are particularly indicated when the acid is excessive. The action of the former continues in the stomach during normal digestion. The malt diastase is often very serviceable given with alkalies.

Of measures which stimulate the glandular activity in chronic dyspepsia lavage is by far the most important, particularly in the forms characterized by the secretion of a large quantity of mucus. Lukewarm water should be used, or, if there is much mucus, a 1-per-cent. salt solution, or a 3- to 5-per-cent. solution of bicarbonate of soda. If there is much fermentation the 3-per-cent. solution of boric acid may be used. It is best employed in the morning on an empty stomach, or in the evening some hours after the last meal in those cases in which there is much nocturnal distress and flatulency. Once a day is, as a rule, sufficient, or, in the case of delicate persons, every second day. The irrigation may be continued until the water which comes away is quite clear. It is not necessary to remove all the fluid after the irrigation. While perhaps in some hands this measure has been carried to extremes, it is one of such extraordinary value in certain cases that it should be more widely employed. When there is an insuperable objection to lavage a substitute may be used in the form of warm alkaline drinks, taken slowly in the early morning or the last thing at night.

Of medicines which stimulate the gastric secretion the most important are the bitter tonics, such as nux vomica, quassia, gentian, calumba, and carda-

Pl. I. [illegible]

mom. These are probably of more value in chronic gastritis than the hydrochloric acid. Of these nux vomica is the most powerful, though none of them have probably any very great stimulating action on the secretion, and influence rather the appetite than the digestion. Of stomachics which are believed to favorably influence digestion the most important are alcohol and common salt. The former would appear to act in moderate quantities by increasing the acid in the gastric juice, and with it probably the pepsin formation. Others hold that it is not so much the secretory as the motor function of the stomach which the alcohol stimulates. In moderate quantities it has certainly no directly injurious influence on the digestive processes. Special care should be taken, however, in ordering alcohol to dyspeptics. If a patient has been in the habit of taking beer or light wines or stimulants with his meals, the practice may be continued if moderate quantities are taken. Beer, as a rule, is not well borne. A dry sherry or a glass of claret is preferable. In the case of women with any form of dyspepsia stimulants should be employed with the greatest caution, and the practitioner should know his patient well before ordering alcohol.

The importance of salt in gastric digestion rests upon the fact that its presence is essential in the formation of the hydrochloric acid. An increase in its use may be advised in all cases of chronic dyspepsia in which the acid is defective.

(*c*) Treatment of Special Conditions.—*Fermentation and Flatulency.*—When the digestion is slow or imperfect, fermentation goes on in the contents, with the formation of gas and the production of lactic, butyric, and acetic acids. For the treatment of this condition careful dieting may suffice, particularly forbidding such articles as tea, pastry, and the coarser vegetables. It is usually combined with pyrosis, in which the acid fluids are brought into the mouth. Bismuth and carbonate of soda sometimes suffice to relieve the condition. Thymol, creasote, and carbolic acid may be employed. For acid dyspepsia Sir William Roberts recommended the bismuth lozenge of the British Pharmacopœia, the antacid properties of which depend on chalk and bicarbonate of soda. It should be taken an hour or two after meals, and only when the pain and uneasiness are present. The burnt magnesia is also a good remedy. Glycerin in from 20- to 60-minim doses, the essential oils, animal charcoal alone or in combination with compound cinnamon powder may be tried. If there is much pain, chloroform in 20-minim doses or a teaspoonful of Hoffman's anodyne may be used. In obstinate cases lavage is indicated and is sometimes striking in its effects. Alkaline solutions may be used.

Vomiting is not a feature which often calls for treatment in chronic dyspepsia; sometimes in children it is a persistent symptom. Creasote and carbolic acid in drop doses, a few drops of chloroform or of dilute hydrocyanic acid, cocaine, bismuth, and oxalate of cerium may be used. If obstinate, the stomach should be washed out daily.

Constipation is a frequent and troublesome feature of most forms of indigestion. Occasionally small doses of mercury, podophyllin, the laxative mineral waters, sulphur, and cascara may be employed. Glycerin suppositories and the injection of from half a teaspoonful to a teaspoonful of glycerin are very efficacious.

Many cases of chronic dyspepsia are greatly benefited by the use of mineral

waters, particularly a residence at the springs with a careful supervision of the diet and systematic exercise.

III. CIRRHOSIS VENTRICULI

(*Plastic Linitis*)

Brinton described under the term linitis plastica a condition of diffuse sclerosis of the stomach with thickening of the walls and reduction of the lumen.

It may be localized, but more commonly involves the whole organ, and a similar condition has been found in the colon, small bowel, and rectum. In the first case I saw, a patient of Dr. Drake's, Montreal, the stomach was no bigger than a cucumber, and the cæcum and part of the ascending colon showed the same thickening. The special lesion is an enormous hypertrophy of the submucosa, with atrophy of the gland elements and hypertrophy of the muscular layers, so that the wall is six to eight times the normal thickness; but, as Brinton remarks, the layers remain distinct. There are two forms, benign and malignant, which are not easy to separate without the most careful microscopic examination. Lyle has collected 118 cases from the literature, more than half of which were the true plastic linitis of Brinton.

The *symptoms* are at first indefinite, but when well established vomiting becomes marked and there is inability to retain even small amounts of food. The presence of a sausage-shaped tumor in the epigastrium is important. Hæmorrhage may be present. The X-ray picture should be of great help. In the only case in which I made a diagnosis the protracted history, the restriction in capacity of the stomach, and the tumor seemed characteristic. Nothing could be done at operation; and in a more recent case the walls were so hard and the stomach so small that it was impossible to make a gastroenterostomy, of which Lyle has reported a successful case. Total gastrectomy has been performed in three cases.

IV. DILATATION OF THE STOMACH

(*Gastrectasis*)

Etiology.—ACUTE DILATATION is a very serious condition, described by Hilton Fagge, characterized by sudden onset, vomiting of enormous quantities of fluid, and symptoms of collapse. Of 102 cases collected by Lewis A. Conner 42 followed operation with general anæsthesia. The next largest group occurs in the course of severe diseases, or during convalescence. Cases have followed injuries, particularly of the head and spine. In 9 cases the symptoms came on after a single large meal; 6 cases were associated with spinal disease, in 3 while the patients were in a plaster of Paris jacket, and in a few cases it has come on in persons in good health. There were 74 deaths. In 69 autopsies the duodenum was found dilated in 38 cases. In a majority of cases it is due to a constriction of the lower end of the duodenum by traction on the mesenteric root, which is particularly apt to occur when there is a

long mesentery and when the coil of small bowel is empty and falls into the true pelvis. The diagnosis is usually easy—repeated vomiting of large quantities of bilious non-fæcal fluid, with subnormal temperature, pain, collapse symptoms, and distended abdomen are the common features. The treatment consists in repeated emptying of the stomach with the tube; change in posture from the dorsal to the belly position or the knee-elbow position has been followed by prompt relief. Operation has not proved very satisfactory.

Chronic dilatation results from: (*a*) *Pyloric obstruction* due to narrowing of the orifice or of the duodenum by the cicatrization of an ulcer, hypertrophic stenosis of the pylorus (whether cancerous or simple) congenital stricture, or occasionally by pressure from without of a tumor or of a floating kidney. The pylorus may be tilted up by adhesions to the liver or gall-bladder, or the stomach may be so dilated that the pylorus is dragged down and kinked. Adhesions about the gall-bladder may extend along the adjacent parts of the stomach and hitch up the pylorus into the hilus of the liver, forming a very acute kink. (*b*) *Relative or absolute insufficiency of the muscular power* of the stomach, due on the one hand to repeated overfilling of the organ with food and drink, and on the other to atony of the coats induced by chronic inflammation or the degeneration of impaired nutrition, the result of constitutional affections.

The most extreme forms are met with as a sequence of the cicatricial contraction of an ulcer. There may be considerable stenosis without much dilatation, the obstruction being compensated by hypertrophy of the muscular coats.

In the second group, due to atony of the muscular coats, we must distinguish between instances in which the stomach is simply enlarged and those with actual dilatation, conditions characterized by Ewald as *megalogastria* and *gastrectasis* respectively. The size of the stomach varies greatly in different individuals, and the maximum capacity of a normal organ Ewald places at about 1,600 c. c. Measurements above this point indicate absolute dilatation.

Atonic dilatation of the stomach may result from weakness of the coats, due to repeated overdistention or to chronic catarrh of the mucous membrane, or to the general muscular debility which is associated with chronic wasting disorders of all sorts. The combination of chronic gastric catarrh with overfeeding and excessive drinking is one of the most fruitful sources of atonic dilatation, as pointed out by Naunyn. The condition is frequently seen in diabetics, in the insane, and in beer-drinkers. In Germany this form is very common in men employed in the breweries. Possibly muscular weakness of the coats may result in some cases from disturbed innervation. Dilatation of the stomach is most frequent in middle-aged or elderly persons, but the condition is not uncommon in children, especially in association with rickets.

Symptoms.—In *atonic dilatation* there may be no symptoms whatever, even with a very greatly enlarged organ; more frequently there are the associated features of neurasthenia, enteroptosis, and nervous dyspepsia; while in a third group there may be all the symptoms of pyloric obstruction—vomiting of enormous quantities, etc. There is no limit to the capacity of the organ in this condition. Gould and Pyle mention an instance in which the stomach held 70 pints!

The features of *pyloric obstruction*, from whatever cause, are usually very evident. Dyspepsia is present in nearly all cases, and there are feelings of distress and uneasiness in the region of the stomach. The patient may complain much of hunger and thirst and eat and drink freely. The most characteristic symptom is the vomiting at intervals of enormous quantities of liquid and of food, amounting sometimes to four or more litres. The material is often of a dark-grayish color, with a characteristic sour odor due to the organic acids present, and contains mucus and remnants of food. On standing it separates into three layers, the lowest consisting of food, the middle of a turbid, dark-gray fluid, and the uppermost of a brownish froth. The microscopic examination shows a large variety of bacteria, yeast fungi, and the sarcina ventriculi. There may also be cherry stones, plum stones, and grape seeds.

The hydrochloric acid may be absent, diminished, normal, or in excess, depending upon the cause of the dilatation. The fermentation produces lactic, butyric, and, possibly, acetic acid and various gases.

In consequence of the small amount of fluid which passes from the stomach or is absorbed there are constipation, scanty urine, and extreme dryness of the skin. The general nutrition of the patient suffers greatly; there is loss of flesh and strength, and in some cases the most extreme emaciation. The gastric tetany will be considered in the section on that disease.

Physical Signs.—*Inspection.*—The abdomen may be large and prominent, the greatest projection occurring below the navel in the standing posture. In some instances the outline of the distended stomach can be plainly seen, the small curvature a couple of inches below the ensiform cartilage, and the greater curvature passing obliquely from the tip of the tenth rib on the left side, toward the pubes, and then curving upward to the right costal margin. Too much stress can not be laid on the importance of inspection. Very often the diagnosis may be made *de visu*. Active peristalsis may be seen in the dilated organ, the waves passing from left to right. Occasionally anti-peristalsis may be seen. In cases of stricture, particularly of hypertrophic stenosis, as the peristaltic wave reaches the pylorus, the tumor-like thickening can sometimes be distinctly seen through the thin abdominal wall. To stimulate the peristalsis the abdomen may be flipped with a wet towel. Inflation may be practiced with carbonic-acid gas. A small teaspoonful of tartaric acid dissolved in an ounce of water is first given, then a rather larger quantity of bicarbonate of soda. In many cases, particularly in thin persons, the outline of the dilated stomach stands out with great distinctness, and waves of peristalsis are seen in it.

Palpation.—The peristalsis may be felt, and usually in stenosis a tumor is evident at the pylorus. The resistance of a dilated stomach is peculiar, and has been aptly compared to that of an air cushion. Bimanual palpation elicits a splashing sound—*clapotage*—which is, of course, not distinctive, as it can be obtained whenever there is much liquid and air in the organ. The splashing may be very loud, and the patient may produce it himself by suddenly depressing the diaphragm, or it may be readily obtained by shaking him. The gurgling of gas through the pylorus may be felt.

Percussion.—The note is tympanitic over the greater portion of a dilated stomach; in the dependent part the note is flat. In the upright position the

Retention of food - 4-8 hours - vibrio-like - early denuded ulcer
spasm - with hyperacidity - vagotonia, salutic diet, adrenalin and [illegible]

percussion should be made from above downward, in the left parasternal line, until a change in resonance is reached. The line of this should be marked, and the patient examined in the recumbent position, when it will be found to have altered its level. When this is on a line with the navel or below it, dilatation of the stomach may generally be assumed to exist. The fluid may be withdrawn from the stomach with a tube, and the dulness so made to disappear, or it may be increased by pouring in more fluid. In cases of doubt the organ should be artificially distended with carbonic-acid gas in the manner described above, or the stomach is inflated through a stomach-tube with a Davidson's syringe.

Auscultation.—The *clapotage* or succussion can be obtained readily. Frequently a curious sizzling sound is present, not unlike that heard when the ear is placed over a soda-water bottle when first opened. It can be heard naturally, and is usually evident when the artificial gas is being generated. The heart sounds may sometimes be transmitted with great clearness and with a metallic quality.

Mensuration may be used by passing a hard sound into the stomach until the greater curvature is reached. Normally it rarely passes more than 60 cm., measured from the teeth, but in cases of dilatation it may pass as much as 70 cm.

Diagnosis.—This can usually be made without much difficulty. I would like to emphasize again the great value of inspection, particularly in combination with inflation of the stomach. Curious errors, however, are on record, one of the most remarkable of which was the confounding of dilated stomach with an ovarian cyst; even after tapping and the removal of portions of food and fruit seeds, abdominal section was performed and the dilated stomach opened. The diagnosis of ascites has been made and the abdomen opened. The *prognosis* depends upon the cause; it is good in simple atony, bad in cancerous stricture, fairly good in simple stricture, from whatever cause.

Treatment.—In the cases due to atony careful regulation of the diet and proper treatment of the associated catarrh will suffice to effect a cure. Strychnine, ergot, and iron are recommended. Washing out the stomach is of great service, though we do not see such striking and immediate results in this form. In cases of mechanical obstruction the stomach should be emptied and thoroughly washed, either with warm water or with an antiseptic solution. We accomplish in this way three important things: We remove the weight, which helps to distend the organ; we remove the mucus and the stagnating and fermenting material which irritates and inflames the stomach and impedes digestion; and we cleanse the inner surface of the organ by the application of water and medicinal substances. The patient can usually be taught to wash out his own stomach, and in a case of dilatation from simple stricture I have known the practice to be followed daily for three years with great benefit. The rapid reduction in the size of the stomach is often remarkable, the vomiting ceases, food is taken readily, and in many cases the general nutrition improves rapidly. As a rule, once a day is sufficient, and it may be practiced either the first thing in the morning or before going to bed. So soon as the fermentative processes have been checked lukewarm water alone should be used.

The food should be taken in small quantities at frequent intervals, and should consist of scraped beef, Leube's beef solution, and tender meats of all sorts. Fatty and starchy articles of diet are to be avoided. Liquids should be taken sparingly.

Surgery should be resorted to early in cases of organic stricture; in atonic dilatation after all other measures have been given a thorough trial, gastro-enterostomy may be practiced.

V. THE PEPTIC ULCER, GASTRIC AND DUODENAL

The round, perforating, simple or peptic ulcer is usually single, and occurs in the stomach and in the duodenum as far as the papilla. Post mortem statistics show a great preponderance of the gastric ulcer, but the enormous experience of surgeons has taught us that in more than fifty per cent. of the clinical cases the ulcer is outside the pyloric ring.

Erosions.—Small abrasions of the mucosa—2 to 4 mm.—usually multiple, are common, extending half way or quite through the layer. They are often called hæmorrhagic erosions from their blood-stained appearance. They are met with in the new-born, in cachectic states in children, in chronic heart and arterial disease, in cirrhosis of the liver, etc. Of no clinical importance, as a rule, occasionally an acute hæmorrhagic erosion of quite small size opens a large artery, and the patient bleeds to death. There is no difference between this condition and the acute form of the gastric ulcer.

In many cases of chronic dyspepsia small fragments of the mucosa are washed out by the stomach tube, and Einhorn thinks that this may be a special form characterized by pains, dyspepsia, and weakness.

In certain acute infections with the pneumococcus (Dieulafoy) and septic organisms there may be hæmorrhagic erosions, which occasionally prove fatal by hæmatemesis.

And, lastly, it is probable that the post-operative hæmatemesis, slight or grave, may be due to these erosions. The French have described them as if peculiar to operations for appendicitis (*vomito-negro appendiculaire*), but cases occur after all sorts of abdominal operations. It is probable that the slight gastric hæmorrhages which occur in connection with the throbbing aorta in neurotic women are due to these erosions.

Etiology of Peptic Ulcer.—Incidence.—The disease is much more common than medical and pathological statistics indicate. The surgical work of the Mayo clinic and of Moynihan of Leeds has taught us that the peptic ulcer exists in many cases which we had regarded as simple hyperchlorhydria. In two points surgical experience has completely changed our medical standpoint, viz.: the incidence of ulcer in the male is greater than in the female, and the duodenal is much more common than the gastric ulcer. Perhaps nothing illustrates more forcibly the frequency of duodenal ulcer than the fact that in the month of July, 1910, 17 cases were operated upon at the Mayo clinic, 5 of which had perforated, and in the same period only three cases of ulcer of the stomach came to operation. The surgical statistics, now amounting to many hundreds of cases, have sent our medical statistics to the scrap heap. The incidence of the disease appears to vary in different localities, and

Eustuman. J.A.M.A. 1915. 65. 1500. Oct 30

Diagnosis ulcer. history. chronicity. recurrence. [illegible] relief [illegible]
nearly all over 1 year. ave. 12 yrs

Diag. bet. Gas. Duod. x rays. history deceptive. position, size & depth.

Gastr. blood in stom. pain & tender. relief by milk
pain ½ to 2 hrs. p.c. gastrectasia.

Diag. from g.b. & appx. in them symptoms are often irregular

Gastr. calculus. mor. crosb. mor. in 20 % g. ulcer.

Mayo Cl. 75% duodenal.

—

Mayo. J.A.M.A. 1915. 65. 1069.

Gastric. 71% in ♂. Duodenal 81%

Smithies. 1775 proved cases. 1125 duodenal + 525 gastric

Infection.

Often abdominal lesions are common.

Ulcer. Gallbladder stomach

post mortem figures from the United States and Canada show a much lower percentage of cases (1.32) than on the continent of Europe (5 per cent.), and in London, 4.2 per cent. (C. P. Howard).

Sex.—Of 1,699 cases collected from hospital statistics by W. H. Welch and examined post mortem, 40 per cent. were in males and 60 per cent. were in females. ~~In 82 cases (J. H. H.) there were 18 males and 28 females—in striking contrast to the Massachusetts General Hospital figures, 5 females to 1 male. Recent~~ Surgical statistics show an enormous preponderance of males.

Age.—In females the largest number of cases occurred between fifteen and twenty-five; in males between forty and fifty, in our series. It may occur in old people. E. G. Cutler ~~has~~ studied a series of 29 cases in children. In 6 the symptoms came on immediately after birth. There were 8 cases under seven years of age, and 9 between eight and thirteen.

~~Heredity appears to play a part in some cases (Dreschfeld).~~

Occupation.—It was impossible in our series to say that occupation had any influence. Among women, chlorotic, dyspeptic servant girls seem very prone. Shoemakers are thought to be specially liable. It appears relatively more common in the hospital classes.

Trauma.—Ulcers have been known to follow a blow in the region of the stomach. There was a history of injury in 7 cases in our series.

Associated Diseases.—Anæmia and chlorosis predispose strongly to gastric ulcer, particularly in women and in association with menstrual disorders. A very considerable number of all cases of gastric ulcer occur in chlorotic girls. It has been found also in connection with disease of the heart, arteriosclerosis, and disease of the liver. The tuberculous and syphilitic ulcers of the stomach have already been considered.

Burns.—The duodenal ulcer may follow large superficial burns. Perry and Shaw found it in ~~five~~ of ~~one hundred and forty-nine~~ autopsies in cases of 149 burns of the skin.

Morbid Anatomy and Pathology.—Ninety per cent. of gastric ulcers are to be found at the pyloric end; nearly all duodenal ulcers are in the first or ascending portion, and more than one-half extend up to or within three-fourths of an inch of the pylorus, while twenty per cent. involve the margin of the pyloric ring (Mayo). It may not be easy on the operating table to distinguish between an ulcer of the duodenum and that of the stomach, but Mayo says that the position of the pyloric vein gives the exact location. Multiple ulcers may occur, 8.2 per cent. in Mayo's series. From 5 to 34 have been found. In the stomach, post mortem statistics (Welch) give, in 793 cases, 288 on the lesser curvature, 235 on the posterior wall, 69 on the anterior wall, 95 at the pylorus, 50 at the cardia, 29 at the fundus, and 27 on the greater curvature.

The acute ulcer is usually small, punched out, the edges clean-cut, the floor smooth, and the peritoneal surface not thickened. The chronic ulcer is of larger size, the margins are no longer sharp, the edges are indurated, and the border is sinuous. It may reach an enormous size, as in the one reported by Peabody, which measured 19 by 10 cm. and involved all of the lesser curvature and spread over a large part of the anterior and posterior walls. The sides are often terraced. The floor is formed either by the submucosa, by the muscular layers, or, not infrequently, by the neighboring organs, to which the

stomach has become attached. In the healing of the ulcer, if the mucosa is alone involved, the granulation tissue grows from the edges and the floor and the newly formed tissue gradually contracts and unites the margins, leaving a smooth scar. In larger ulcers which have become deep and involved the muscular coat the cicatricial contraction may cause serious changes, the most important of which is narrowing of the pyloric orifice and consequent dilatation of the stomach. In the case of a girdle ulcer hour-glass contraction of the stomach may be produced. Large ulcers persist for years without any attempt at healing.

Among the more serious changes which may proceed in an ulcer are the following:

Perforation.—This occurred in 28.1 per cent. of 1,871 cases collected by Musser. In some series (Mayo's) duodenal perforation is the more common. Of 272 cases of duodenal ulcer in Mayo's series (to June 1, 1908), perforation was found sixty-six times, 16 acute, 13 subacute with abscess, and 37 chronic and protected. Perforation of the anterior wall of the stomach usually excites an acute peritonitis. On the posterior wall the ulcer penetrates directly into the lesser peritoneal cavity, in which case it may produce an air-containing abscess with the symptoms of the condition known as subphrenic pyopneumothorax. In rare instances adhesions and a gastrocutaneous fistula form, usually in the umbilical region. Fistulous communication with the colon may also occur, or a gastroduodenal fistula. The pericardium may be perforated, and even the left ventricle. Perforation into the pleura may also occur. It is to be noted that general emphysema of the subcutaneous tissues occasionally follows perforation of a gastric ulcer.

Erosion of Blood-vessels.—In both forms of ulcer hæmorrhage occurs, in 8.1 per cent. of Musser's series of 1,871 cases. In Moynihan's 114 cases of duodenal ulcer, hæmorrhage occurred in 41. It is more common in the chronic form. Ulcers on the posterior wall may erode the splenic artery, but perhaps more frequently the bleeding proceeds from the artery of the lesser curvature. In the case of duodenal ulcer the pancreaticoduodenal artery may be eroded, or (as in one of my cases) fatal hæmorrhage may result from the opening of the hepatic artery, or more rarely the portal vein. Interesting changes occur in the vessels. Embolism of the artery supplying the ulcerated region has been met with in several cases; in others diffuse endarteritis. Small aneurisms have been found in the floor of the ulcers by Douglas Powell, Welch, and others. A rare event is emphysema of the sub-peritoneal tissue, which may be very extensive and even pass on to the posterior mediastinum. Jurgensen ascribes it to entrance of air into the veins, but Welch thinks it represents an invasion with the gas bacillus.

Cicatrization.—Superficial ulcers often heal without leaving any serious damage. Stenosis of the pyloric orifice not infrequently follows the healing of an ulcer in its neighborhood. In other instances the large annular ulcer may cause in its cicatrization an hour-glass contraction of the stomach. The adhesion of the ulcer to neighboring parts may subsequently be the cause of much pain. The parts of the mucosa in the neighborhood of the ulcer frequently show signs of chronic gastritis.

Perigastric Adhesions.—The condition is common, as high as 5 per cent. of post mortem records. It follows ulcer, lesions of the gall-bladder,

Gastric pain – continuous + colicky with vomit.

Continuous – carcinoma, marked pyloric obstruction. Appendicular abscess with peritoneal involvement

Intermittent – 1. immediate. Ptosis – neurosis, cardiac obstruction – duodenal achylia.

2. early – 15–60 min. p.c. – often adhesions, e.g. duodenal hernias + pericholecystitis – often chronic ulcer & sec. & rarely carcinoma

3. late – 1–3 hrs. p.c.
chronic ulcer & benign pyloric stenosis often duodenal ulcer

Small & soft gastric ulcer

Peripheral carcinoma. [illegible] history. Patient [illegible] anaemic. Can without [illegible]

Symptoms: Pain – variably described – usually epigastric – referred back (2/3 to left post. scap. right rib margin. below navel. left scapular tip)
In more than 75% with [illegible] pain – relieved by food – vomit rare unless pyloric obstruction (pyloric obstruction changes)
Vomiting. 1/4 give history. Most common in ulcer near pylorus (stasis?)
Haem. in 1/3.
Signs & Tenderness. 95%. usually to right.
Test meal. 2/3 some evidence retained contents. If often in ulcer indicative for operation.
Radiology. [illegible]
Hct & T.D. [illegible] & chronic ulcer & carcinoma. If & malignant Hct [illegible]

pancreatic disease, syphilitic disease of the liver, and chronic tuberculosis. In some instances the lesions are quite extensive, and the condition has been called plastic perigastritis. It may be associated, too, with hypertrophic thickening of the coats of the stomach and with chronic plastic peritonitis. In some instances the pylorus may be narrowed as a result of the adhesions, or a sort of hour-glass stomach may be produced, or the motility of the organ is interfered with. Pain is the most constant feature, and may simulate that of gastric ulcer or of hyperacidity, and may be present constantly or at intervals. It is much influenced by posture and usually relieved by pressure. Local tenderness is present in a majority of instances. The cases are chronic, the general health is but slightly interfered with, and there are not, as a rule, signs of gastric dilatation. A definite tumor may be present about the region of the pylorus.

Carcinoma and Ulcer.—The observations at the Mayo clinic by Wilson and MacCarty show a much closer relationship between these conditions than we had previously supposed. The latter author, who has made a study of 216 resections of the stomach for ulcer or cancer, concludes that 71 per cent. of the resected specimens of cancer were associated with ulcer, and that 68 per cent. of the resected gastric ulcers were associated with cancer.

Mode of Origin.—The mode of origin is unknown. The anatomical basis is an interference with the blood supply in a limited area of the mucosa, attributed to embolism, thrombosis, or spasm of the arteries. As they are not end vessels, simple obstruction can not account for it. Trophic influences, bacterial necrosis of the mucosa, spasm of the muscular coat in limited areas, etc., are among the hypotheses which have been advanced. The erosion is effected by the gastric juice, and the healing is probably retarded by its high grade of acidity.

A few cases of acute duodenal ulcer have a curious relation with superficial burns. Bardeen's researches upon the necroses in the viscera following extensive burns throw an important light upon these cases, showing especially how the gastro-intestinal mucous membrane is implicated in the toxic effects.

Jejunal Peptic Ulcer.—This may occur after gastrojejunostomy, but in many cases the ulcer involves both stomach and jejunum. The condition is rare, as after 1,141 gastrojejunostomies at the Mayo clinic not one developed an ulcer.

Symptoms.—The condition may be latent and only met with accidentally, post mortem. The first symptoms may be those of perforation. In other cases again, for months and years, the patient has had dyspepsia, and the ulcer may not have been suspected until the occurrence of a sudden hæmorrhage.

Dyspepsia may be slight and trifling or of a most aggravated character. In a considerable proportion of all cases nausea and *vomiting* occur, the latter not for two or more hours after eating. The vomitus usually contains a large amount of hydrochloric acid.

Hæmorrhage is present in at least one-third of all cases. It may be latent (occult). A patient may feel faint and turn pale and sweat; the next day the stools may be tarry from the blood that has passed into the small bowel. These concealed hæmorrhages are more often small, and the blood is not readily seen in the vomitus or stools. Weber's test may be tried; the

fluid to be examined is mixed with 2 or 3 c. c. of glacial acetic acid, and then shaken with sulphuric ether. If blood be present the ethereal extract has a Tokay wine-like color. Meat should not be eaten for a few days before the test is made. These small, latent hæmorrhages may cause a slowly progressive anæmia. More commonly the bleeding is profuse, and the blood may be in such quantities and brought up so quickly that it is fluid, bright red in color, and quite unaltered. When it remains for some time in the stomach and is mixed with food it may be greatly changed, but the vomiting of a large quantity of unaltered blood is very characteristic of ulcer. As a rule, there are only one or two attacks; in our series 7 cases had one hæmorrhage, 7 two, 11 three, 1 four, and 15 many (Howard). Profuse bleedings may occur at intervals for many years. Death may follow directly. From 16 to 18 per cent. of the fatal cases are due to it (S. and W. Fenwick).

The immediate effect of the hæmorrhage is a severe anæmia, from which it may take months to rally; slight fever is common. Rare and untoward effects are convulsions, sometimes only the usual convulsions of extreme cerebral anæmia from which recovery takes place, or they may precede a hemiplegia, due probably to thrombosis.

Amaurosis may follow the hæmorrhage, and unfortunately may be permanent, due to degeneration of the retinal ganglion cells, or to a thrombosis of the cerebral arteries or veins.

Pain is perhaps the most constant and distinctive feature of ulcer. It varies greatly in character; it may be only a gnawing or burning sensation, which is particularly felt when the stomach is empty, and is relieved by taking food, but the more characteristic form comes on in paroxysms, in which the pain is not only felt in the epigastrium, but radiates to the back and to the sides. In many cases the two points of epigastric pain and dorsal pain, about the level of the tenth dorsal vertebra, are very well marked. These attacks are most frequently induced by taking food, and they may recur at a variable period after eating, sometimes within fifteen or twenty minutes, at others as late as two or three hours. It is usually stated that when the ulcer is near the cardia the pain is apt to set in earlier, but there is no certainty on this point. In some cases it comes on in the early morning hours. The attacks may occur at intervals with great intensity for weeks or months at a time, so that the patient constantly requires morphia, then again they may disappear entirely for a prolonged period. In the attack the patient is usually bent forward, and finds relief from pressure over the epigastric region; one patient during the attack would lean over the back of a chair; another would lie flat on the floor, with a hard pillow under the abdomen. ~~Pressure is, as a rule, grateful~~. It has been thought that the posture assumed during the attack would indicate the site of the ulcer, but this is very doubtful.

Tenderness on pressure is a common symptom in ulcer, and patients wear the waist-band very low. Pressure should be made with great care, as rupture of an ulcer is said to have been induced by careless manipulation.

In old ulcers with thickened bases an indurated mass may be felt in the neighborhood of the pylorus.

Of general symptoms, *loss of weight* results from the prolonged dyspepsia, but it rarely, except in association with cicatricial stenosis of the pylorus, reaches the high grade met with in cancer. The *anæmia* may be extreme, and

Chronic ulcer - [illegible] health in between.

Intravenous injection of chloroform - hyperemesis - may be fatal. Injury of stomach-duodenum - acute necrosis. (Ramsay)

Duodenal ulcer. x-ray diag. Hypermotility - hypotonus, deformity of the cap or bulb, tenderness in bulb, pressure point over duod. Spasm of stomach can mimic ulcer. Hypersecretion & blood vomiting or a diverticulum - in obscure cases stom. can only evidence ulc. & x-ray diag. can be safely made.

Bulb deformity or hypersecretion with vomiting - are present in duodenal ulcer.

Frankfort q.p. 493.

a. Stew. in 45°. omnibus punctata. Bleeding in stom. gastr. is in hematemesis. Occult blood test not very reliable.

5. Blood in stools 3%. more constant if malignant change.

6. x-ray - most val. for stenosis - hour-glass stomach. [illegible]

in one case of duodenal ulcer, which I examined, the blood-count was as low as 700,000 per c. mm. Of 44 cases in my wards in which blood-counts were made, the lowest was 1,902,000 per c. mm. There are instances, such as the one reported by Pepper and Griffith, in which the extreme anæmia can not be explained by the occurrence of hæmorrhage. In a few instances polycythæmia is present, even after a hæmorrhage, due to concentration of the blood and possibly associated dilatation of the stomach. In a few cases *parotitis* occurs, with the perforation sometimes, or after a hæmorrhage. In one of my cases there was a remarkable *pigmentation* of the face and of the axillary folds.

PERFORATION.—This occurred in 28.1 per cent. of Musser's series. The acute, perforating form is much more common in women than in men. The symptoms are those of perforative peritonitis. Particular attention must be given to this accident, since it has come so successfully within the sphere of the surgeon. As already mentioned, perforation may take place either into the lesser peritoneum or into the general peritoneal cavity, in both of which cases operation is indicated; in rare instances the ulcer may perforate the pericardium. This was the case in 10 of 28 cases in which the diaphragm was perforated (Pick).

Localized, more frequently subphrenic, abscess may follow perforation.

URINE.—Albumin is occasionally present; in 14 of our series with dilatation of the stomach. Indican may be present. Acetone and diacetic acid (with syncopal attacks) have been described by Dreschfeld.

HOUR-GLASS STOMACH most frequently results from the cicatrization of an ulcer. In a few cases it is congenital. The symptoms, fairly characteristic, are thus given by Moynihan:

(*a*) In washing out the stomach part of the fluid is lost. (*b*) If the stomach is washed clean, a sudden reappearance of stomach contents may take place. (*c*) "Paradoxical dilatation"; when the stomach has apparently been emptied, a splashing sound may be elicited by palpation of the pyloric segment. (*d*) After distending the stomach, a change in the position of the distention tumor may be seen in some cases. (*e*) Gushing, bubbling, or sizzling sounds are heard on dilatation with carbon dioxide at a point distinct from the pylorus. (*f*) In some cases, when both parts are dilated, two tumors with a notch or sulcus between are apparent to sight or touch. To these may now be added (*g*) a most characteristic X-ray picture.

Prognosis.—In all statistics the acute and chronic ulcer have been considered together. The former is more amenable to medical treatment, but grave complications may occur even before the digestive symptoms have been very pronounced. The chronic ulcer may last for years—twelve, eighteen, or even twenty—with intervals of good health. The all-important point in the prognosis relates to the question of medical or surgical treatment—which gives the best results? So far as figures count, the exhaustive study of Musser favors the former, 12.4 per cent. mortality against 20 per cent. for the latter. This for simple cases including complications. In private practice many series of cases have not a mortality above 6 per cent. The mortality of the chronic peptic ulcer in the hands of such experts as the Mayos and Moynihan is very low. In 311 gastrojejunostomies for ulcer of the stomach and duodenum the mortality was less than 1 per cent., and only three patients re-

quired a secondary operation (Mayo's). In Moynihan's cases of duodenal ulcer, 114 in number (exclusive of perforation), there were only two deaths. The end results of gastro-enterostomy for the chronic ulcer appear to be excellent.

Diagnosis.—The acute non-indurated ulcer may cause very few symptoms—nothing beyond ordinary dyspepsia with pain. Examination of the stomach contents shows an increase in the free HCl. Hæmatemesis may be the first symptom of moment. This group of cases is seen chiefly in young girls, and appears to be much more common in England than in the United States. A condition which may be confounded with it is *gastrostaxis*, described by Hale White. The stomach symptoms are marked, the bleeding may be profuse, but post mortem or at operation no ulcer is found. Of course very careful inspection must be made, as fatal bleeding may come from a very small erosion. The symptoms of non-indurated mucous ulcer yield to a few months' medical treatment.

In the chronic cases the nutrition at first may remain good, and the patient looks well. The whole complaint is of the stomach, of pain and distress, with belching and nausea or vomiting from two to four hours after meals. This special feature of the recurrence of the pain some hours after taking food, its extraordinary regularity, persisting day by day for months or even years, and the relief afforded by taking food clearly separate the dyspeptic features of ulcer from other types.

Einhorn has introduced an ingenious *thread test*. A perforated olive with a long white thread attached is swallowed and remains in the stomach for 10 or 12 hours. If an ulcer, gastric or duodenal, is present, there is a stain corresponding to the part of the thread that has lain in contact with the ulcer, and the position on the thread gives an idea of the distance of the ulcer from the cardia.

Treatment.—Post mortem observations show that a very large number of ulcers heal completely, but the process is slow and tedious, often requiring months, or, in severe cases, years. The following are the important points in treatment:

(*a*) Absolute rest in bed.

(*b*) A carefully and systematically regulated diet. While theoretically it is better to give the stomach complete rest by rectal feeding, yet in practice this strict limitation is not found satisfactory. The food should be bland, easily digested, and given at stated intervals. The following dietary will be found useful: At 8 a. m. give 200 c. c. of Leube's beef solution; at 12 m., 300 c. c. of milk gruel or peptonized milk. The gruel should be made with ordinary flour or arrowroot, and is mixed with an equal quantity of milk. If necessary it may be peptonized. Buttermilk is very well borne by these patients. At 4 p. m. the beef solution again, and at 8 p. m. the milk gruel or the buttermilk.

The stomach in some cases is so irritable that the smallest amount of food is not well borne. In such cases lavage may be practiced, if necessary, every morning, with mildly alkaline water, after which the beef solution is given and the feeding supplemented by the rectal injections. Ill effects rarely follow the careful use of the stomach tube in gastric ulcer. There are some patients who do well from the outset on a milk diet, given at regular intervals.

Transduodenal Bands. eg. from g.b. accessorius.
ant. symptoms & signs. — Gastroptosis of stomach — Lesser curvature
but esp. pylorus more like gallstones. Find visible adhesions not visible
more like pylorus or duodenal ulcer. Blood never found.
x-ray more like duodenal than gastric ulcer. Bands may simulate
chr. duodenal ulcer + cholecystitis.
Gen. inspection of case reveals incipient emphysema.
Division of bands useful. but + plastic (Heaney) most useful

— —

End results: Lund. up Journ. J. of Med. Nov. 21. '14.

Diagnosis very difficult.

Dr Fenwick by the duodenal tube is

Men - 1 qq 1½ oz. water 4 oz. milk	very hour 7 a.m. to 7 p.m. ½ oz. 1st day + water ½-oz. for 6 days ½ 30 z. each feeding. Kept him 4 days

7-10 day - 1 20th qq. + water + salt meal - 2 tablesp.

Stopped beef tea.

Vicenz. good - Butter after 10th day.

for 2 mos. 3 small meals a day + eggs milk + cream. Rest.

for a year. Diet of hospital diet.

and - [illegible]

[illegible]

3 or 4 ounces every two hours. When milk is not well borne egg albumen may be substituted, or the whites of eight eggs may be alternated with Leube's beef solution. At the end of a month, if the condition has improved, the patient may be allowed scraped beef or young chicken, perfectly fresh sweetbread, and farinaceous puddings made with milk and eggs. Local applications, such as warm fomentations, over the abdomen are very useful. The patient should be told that the treatment will take at least three months, and for the greater portion of the time he should be in bed.

(*c*) Medicinal measures are of very little value in gastric ulcer, and the remedies employed probably do not benefit the ulcer, but the gastric catarrh. The Carlsbad salts are warmly recommended by von Ziemssen. The artificial preparation (sulphate of sodium, 50 parts; bicarbonate of sodium, 6; chloride of sodium, 3) may be substituted, of which a teaspoonful is taken every morning. Bismuth, in doses of 30 to 60 grains (2 to 4 gm.) three times a day, and nitrate of silver may be given, but they influence the associated conditions rather than the ulcer.

The pain, if severe, requires opium. Unless the gastralgia is intense morphia should not be given hypodermically, as there is a very serious danger in these cases of establishing the morphia habit. Doses of an eighth of a grain, with the bicarbonate of soda and bismuth, will allay the mild attacks, but the very severe ones require the hypodermic injection of a quarter or often half a grain. Antipyrin and antifebrin may be tried, but, as a rule, are quite ineffectual. In the milder attacks Hoffman's anodyne, or 20 or 30 drops of spirit of chloroform, or the spirits of camphor, will give relief. Counter-irritation over the stomach with mustard or cantharides is often useful.

When the stomach is irritable, the patient should be fed per rectum. He will sometimes retain food which is passed into the stomach through the tube, and Leube's beef solution or milk may be given in this way. Cracked ice, chloroform, oxalate of cerium, and bismuth may be tried. When hæmorrhage occurs the patient should be put under the influence of opium as rapidly as possible. No attempt should be made to check the hæmorrhage by administering medicines by the mouth; as the profuse bleeding is always from an eroded artery, frequently from one of considerable size, it is doubtful if acetate of lead, tannic and gallic acids, and the usual remedies have the slightest influence. The essential point is to give rest, which is best obtained by opium. Nothing should be given by the mouth except small quantities of ice. In profuse bleeding the extremities may be tightly bandaged. Not infrequently the loss of blood is so great that the patient faints. A fatal result is not, however, very common from hæmorrhage. Transfusion, direct from artery to vein by Crile's method, or the subcutaneous infusion of saline solution, may be necessary.

The patients usually recover rapidly from the hæmorrhage and require iron in full doses, which may, if necessary, be given hypodermically.

Surgical interference is indicated: (1) For perforation; (2) in the chronic indurated ulcer. Experience has shown that after gastro-enterostomy the ulcer heals rapidly, and in some cases the ulcer itself may be located; (3) in all cases when the ulcer has caused mechanical interference with the passage of the gastric contents; (4) in all cases associated with recurring hæmorrhages. In young girls the single severe attack of hæmatemesis may

be a simple gastrorrhexis, or from a simple ulcer that heals readily, but in men severe hæmatemesis is almost always from the chronic ulcer; (5) in the perigastric adhesions after chronic ulcer operation is sometimes helpful; (6) in chronic cases in which medical treatment fails to give relief.

In the present state of our knowledge it is not easy to determine the limits of medical and surgical practice in the treatment of peptic ulcer. The old statistics are not of much avail, since it is quite clear that scores of cases have been masquerading under the names of hyperchlorhydria, acid dyspepsia, and so forth. The simple non-indurated ulcer is, in the majority of cases, a medical disease. A chronic indurated form is best treated surgically.

VI. CANCER OF THE STOMACH

Etiology.—Incidence.—In an analysis of 30,000 cases of cancer, W. H. Welch found the stomach involved in 21.4 per cent., this organ thus standing next to the uterus in order of frequency. Among 8,464 cases admitted to my wards, there were 150 cases of cancer of the stomach. There were 39 cases among the first 1,000 autopsies in the post mortem room of the Johns Hopkins Hospital. The disease is more common in some countries. Figures indicate that cancer of the stomach, as of other organs, is increasing in frequency.

Sex.—In 150 cases from my wards there were 126 males and 24 females (McCrae). Welch gives the ratio as 5 to 4.

Age.—Of our 150 cases the ages were as follows: Between twenty and thirty, 6; from thirty to forty, 17; forty to fifty, 38; fifty to sixty, 49; sixty to seventy, 36; seventy to eighty, 4. Fifty-eight per cent. occurred between the ages of forty and sixty. Of the 6 cases occurring under the thirtieth year, the youngest was twenty-two. Of the large number of cases analyzed by Welch, three-fourths occurred between the fortieth and seventieth years. Congenital cancer of the stomach has been described, and cases have been met with in children.

Race.—Among our 150 cases, 131 were white; 19 were negroes.

Heredity.—Of the 150 cases in only 11 was there a positive history of cancer in the family. In some families, as the Bonapartes, the disease seems to prevail. In our series a very much larger number—38—had a family history of tuberculosis.

Previous Diseases, Habits, Etc.—A history of dyspepsia was present in only 33 cases; of these, 17 had had attacks at intervals, 11 had had chronic stomach trouble, and 5 had had dyspepsia for one or two years before the symptoms of cancer developed. Napoleon, discussing this interesting point with his physician Antommarchi, said that he had always had a stomach of iron and felt no inconvenience until the onset of what proved to be his fatal illness.

Alcohol.—Seventy-seven of our patients had used it regularly, 65 of these moderately (?), 8 excessively.

Trauma.—Only one case gave a positive history. In one case the cancer followed rapidly upon a blow on the stomach, and the patient lost sixty pounds in weight in three months.

Smithsonian Misc. Coll. (Oct. 1961)
Vol. 142

Gastric Ulcer.—The relation to this condition is in dispute—the physicians are against, the surgeons are in favor. In only 4 cases in my series was there a history pointing to ulcer. On the other hand, in the Mayo clinic nearly 75 per cent. of the cancers are believed to originate in ulcer.

Morbid Anatomy.—The most common varieties of gastric cancer are the cylindrical-celled adeno-carcinoma and the encephaloid or medullary carcinoma; next in frequency is scirrhous, and then colloid cancer. With reference to the situation of the tumor, Welch analyzed 1,300 cases, in which the distribution was as follows: Pyloric region, 791; lesser curvature, 148; cardia, 104; posterior wall, 68; the whole or greater part of the stomach, 61; multiple tumors, 45; greater curvature, 34; anterior wall, 30; fundus, 19.

The medullary cancer occurs in soft masses, which involve all the coats of the stomach and usually ulcerate early. The tumor may form villous projections or cauliflower-like outgrowths. It is soft, grayish-white in color, and contains much blood. The cylindrical-celled epithelioma may also form large irregular masses, but the consistence is usually firmer, particularly at the edges of the cancerous ulcers. Cysts are not uncommon in this form. The scirrhous variety is characterized by great hardness, due to the abundance of the stroma and the limited amount of alveolar structures. It is seen most frequently at the pylorus, where it is a common cause of stenosis. It may be combined with the medullary form. It may be diffuse, involving all parts of the organ, and leading to a condition which can not be recognized macroscopically from cirrhosis. This form has also been seen in the stomach secondary to cancer of the ovaries. In connection with the diffuse carcinomatosis there may be simultaneous involvement of the small and large intestines. The colloid cancer is peculiar in its wide-spread invasion of all the coats. It also spreads with greater frequency to the neighboring parts, and it occasionally causes extensive secondary growths of the same nature in other organs. The appearance on section is very distinctive, and even with the naked eye large alveoli can be seen filled with the translucent colloid material. The term alveolar cancer is often applied to this form. Ulceration is not constantly present, and there are instances in which, with most extensive disease, digestion has been but slightly disturbed. There is a specimen in the Warren Museum, at the Harvard Medical School, of the most widespread colloid cancer, in which the stomach contained after death large pieces of undigested beef-steak.

Secondary Cancer of the Stomach.—Of 37 cases collected by Welch, 17 were secondary to cancer of the breast. Among the first 1,000 autopsies at the Johns Hopkins Hospital there were 3 cases of secondary cancer.

Changes in the Stomach.—Cancer at the cardia is usually associated with wasting of the organ and reduction in its size. The œsophagus above the obstruction may be greatly dilated. On the other hand, annular cancer at the pylorus causes stenosis with great dilatation of the organ. In a few rare instances the pylorus has been extremely narrowed without any increase in the size of the stomach. In diffuse scirrhous cancer the stomach may be very greatly thickened and contracted. It may be displaced or altered in shape by the weight of the tumor, particularly in cancer of the pylorus; in such cases it has been found in every region of the abdomen, and even in the true pelvis. The mobility of the tumors is at times extraordinary and

very deceptive, and they may be pushed into the right hypochondrium or into the splenic region, entirely beneath the ribs. Adhesions very frequently occur, particularly to the colon, the liver, and the anterior abdominal wall.

Secondary cancerous growths in other organs are very frequent, as shown by the following analysis by Welch of 1,574 cases: Metastasis occurred in the lymphatic glands in 551; in the liver in 475; in the peritoneum, omentum, and intestine in 357; in the pancreas in 122; in the pleura and lung in 98; in the spleen in 26; in the brain and meninges in 9; in other parts in 92. The lymph glands affected are usually those of the abdomen, but the cervical and inguinal glands are not infrequently attacked, and give an important clue in diagnosis. Secondary metastatic growths occur subcutaneously, either at the navel or beneath the skin in the vicinity, and are of great value in diagnosis.

Perforation.—This occurred into the peritoneum in 17 of the 507 cases of cancer of the stomach collected by Brinton. In our series perforation occurred in 4 cases. When adhesions form, the most extensive destruction of the walls may take place without perforation into the peritoneal cavity. In one instance which came under my observation a large portion of the left lobe of the liver lay within the stomach. Occasionally a gastro-cutaneous fistula is established. Perforation may occur into the colon, the small bowel, the pleura, the lung, or into the pericardium.

Symptoms.—Latent Carcinoma.—The cases are not very infrequent. There may be no symptoms pointing to the stomach, and the tumor may be discovered accidentally after death. In a second group the symptoms of carcinoma are present, not of the stomach, but of the liver or some other organ, or there are subcutaneous nodules, or, as in one of our cases, secondary masses on the ribs and vertebræ. In a third group, seen particularly in elderly persons in institutions, there is gradual asthenia, without nausea, vomiting, or other local symptoms.

Features of Onset.—Of the 150 cases in our series, 48 complained of pain, 44 of dyspepsia, 21 of vomiting, 13 of loss in weight, 3 of difficulty in swallowing, 1 of tumor. In 7 the features of onset suggested pernicious anæmia. In 37 cases there was a history of sudden onset.

General Symptoms.—*Loss of Weight.*—Progressive emaciation is one of the most constant features of the disease. In 79 of our cases in which exact figures were taken: To 30 pounds, 32 cases; 30 to 50 pounds, 36 cases; 50 to 60 pounds, 5 cases; 60 to 70 pounds, 4; over 70 pounds, 1; 100 pounds, a case of cancer at the cardiac end with obstruction to swallowing. The loss in weight is not always progressive. We see increase in weight under three conditions: (*a*) Proper dieting, with treatment of the associated catarrh of the stomach; (*b*) in cases of cancer of the pylorus after relief of the dilatation of the organ by lavage, etc.; (*c*) after a profound mental impression. I have known a gain of ten pounds to follow the visit of an optimistic consultant. In Keen and D. D. Stewart's case there was a gain of seventy pounds after an exploratory operation!

Loss in strength is usually proportionate to the loss in weight. One sees sometimes remarkable vigor almost to the close, but this is exceptional.

Anæmia is present in a large proportion of all cases, and with the emaciation gives the picture of cachexia. There is often a yellow or lemon tint of

the skin. In 59 cases careful blood-counts were made; in 3 the red corpuscles were above 6,000,000 per c. mm. This occurs in the concentrated condition of the blood in certain cases of cancer of the pylorus with dilatation of the stomach. The average count in the 59 cases was 3,712,186 per c. mm. In only 8 cases was the count below 2,000,000, and in none below 1,000,000. The average of the hæmoglobin was 44.9 per cent. In only 9 was it below 30 per cent. In 62 cases in which the leucocytes were counted there were only 18 cases in which they were above 12,000 per c. mm.; in only 3 cases were they above 20,000. The features of onset may suggest a primary anæmia.

Among other general symptoms may be mentioned *fever*, which was present at some time in 74 of our 150 cases. In only 13 of these did the temperature rise above 101°. In 2 it was above 103°. Fifteen presented fairly constant elevation of temperature. Eight presented sudden rises. Two cases had *chill*, with elevation to 103° and 104°. Chills may be associated with suppuration at the base of the cancer.

Urine.—There may be no changes throughout; in 65 of our cases there were no alterations, in 36 albumin was found, and in 31 albumin with tube-casts. Glycosuria, peptonuria, and acetonuria have been described. Indican is common.

Œdema.—Swelling of the ankles is of frequent occurrence toward the close. In some cases there is even early a general anasarca, usually in combination with extreme anæmia. The cancer is usually overlooked.

The *bowels* are often constipated. In only 12 cases in our series was diarrhœa present. In 2 cases blood was passed per rectum. There are no special *cardiac symptoms:* the pulse becomes progressively weaker. Thrombosis of one femoral vein may occur, or, as in one of our cases, wide-spread thrombosis in the superficial veins of the body.

Symptoms on the part of the nervous system are rare; consciousness is often retained to the end. *Coma* may occur similar to that seen in diabetes, and is believed to be due to an acid intoxication.

Functional Disturbances.—*Anorexia,* loss of desire for food, is a frequent and valuable symptom, more constant perhaps than any other. *Nausea* is a striking feature in many cases; there is often a sudden repulsion at the sight of food. In exceptional cases the appetite is retained throughout.

Vomiting may come on early, or only after the dyspepsia has persisted for some time. It occurred in 128 cases in our series. At first it is at long intervals, but subsequently it is more frequent, and may recur several times in the day. There are cases in which it comes on in paroxysms and then subsides; in other cases it sets in early, persists with great violence, and may cause a fatal termination within a few weeks. Vomiting is more frequent when the cancer involves the orifices, particularly the pylorus, in which case it is usually delayed for an hour or more after taking the food. When the cardiac orifice is involved it may follow at a shorter interval. Extensive disease of the fundus or of the anterior or posterior wall may be present without the occurrence of vomiting. The food is sometimes very little changed, even after it has remained in the stomach for twenty-four hours.

Hæmorrhage occurred in 36 of our 150 cases; in 32 the blood was dark and altered, in 3 it was bright red. In 2 cases vomiting of blood was the first symptom. The bleeding is rarely profuse; more commonly there is

slight oozing, and the blood is mixed with, or altered by, the secretions, and, when vomited, the material is dark brown or black, the so-called "coffee-ground" vomit. The blood can be recognized by the microscope as shadows of the red blood-corpuscles and irregular masses of altered blood pigment. Occult blood may be found in the fæces.

Pain, an early and important symptom, was present in 130 of our cases. It is very variable in situation and, while most common in the epigastrium, it may be referred to the shoulders, the back, or the loins. The pain is described as dragging, burning, or gnawing in character, and very rarely occurs in severe paroxysms, as in gastric ulcer. As a rule, the pain is aggravated by taking food. There is usually marked tenderness on pressure in the epigastric region. The areas of skin tenderness are referred, as Head has shown, to the region between the nipple and the umbilicus in front and behind from the fifth to the twelfth thoracic spine.

Examination of the Stomach Contents.—The vomitus in suspected cases should be carefully studied, particularly as to quantity and character of ingredients. Large amounts brought up at intervals of a few days, with the appearances already described, are characteristic of dilatation of the stomach. Some of the material should be spread in a large glass plate and any suspicious portions picked out for examination. Bacteria in large numbers occur, one, the Oppler-Boas bacillus—an unusually long non-motile form—is supposed to be of diagnostic value, and to be largely responsible for the formation of lactic acid. The yeast fungus is very commonly found, sarcinæ less frequently than in dilatation from stricture. Blood is a most important ingredient; the persistent presence microscopically of red corpuscles in the early morning washings is always very suspicious. Later, when coffee-ground vomiting takes place, the macroscopic evidence is sufficient. In cases of doubt the spectroscope may be used or the test made for hæmin crystals. Fragments of the new growth may be vomited or may appear in the washings. Positive evidence of cancer may be obtained from them.

Examination of the Test Breakfast.—The Ewald test meal, consisting of a slice of stale bread and a large cup of weak tea without cream or sugar, is given at 7 a. m. and withdrawn at 8 a. m. The Boas test meal, consisting of a gruel made of a tablespoonful of oatmeal flour in a litre of water, is used in the estimation of lactic acid. As an outcome of the enormous number of observations made of late years, it may be said that free HCl is absent in a large proportion of all cases of cancer of the stomach. Of 94 cases in which the contents were examined in 84 free HCl was absent. In 5 undoubted cases the reaction was good; in 2 of these the history suggested previous ulcer. HCl may be absent in chronic gastritis and in atrophy of the gastric mucosa. The presence of lactic acid after Boas' test meal is regarded as a valuable sign.

Physical Examination.—*Inspection.*—After a preliminary survey, embracing the facies, state of nutrition, etc., particular attention is given to the abdomen. An all-important matter is to have the patient in a good light. Fullness in the epigastric region, inequality in the infracostal grooves, the existence of peristalsis, a wide area of aortic pulsation, the presence of subcutaneous nodules or small masses about the navel, and, lastly, a well-defined tumor mass—these, together or singly, may be seen on careful inspection.

I can not emphasize too strongly the value of this method of examination. In 62 of the 150 cases a positive tumor could be seen. In 52 the tumor descended with inspiration; in 36 peristalsis was visible; in 3 cases movements were visible in the tumor itself. In 10 cases with visible peristalsis no tumor was seen, but could be felt on palpation. Inflation with carbonic-acid gas may be tried, except when hæmorrhage has been profuse or the cancer is very extensive. The dilatation often renders evident the peristalsis or may bring a tumor into view. The presence of subcutaneous and umbilical nodules is sometimes a very great help. They were found in 5 of our series.

Palpation.—In 115 cases a tumor could be felt; in 48 in the epigastric region, in 25 in the umbilical, in 18 in the left hypochondriac, in 17 in the right hypochondriac region, while in 7 cases a mass descended in deep inspiration from beneath the left costal margin. These figures illustrate in how large a proportion of the cases the tumor is in evidence. In rare cases examination in the knee-elbow position is of value. *Mobility* in gastric tumor is a point of much importance. First, the change with respiration, already referred to; a mass may descend 3 or 4 inches in deep inspiration; secondly, the communicated pulsation from the aorta, which is often in its extent suggestive; thirdly, the intrinsic movements in the hypertrophied muscularis in the neighborhood of the cancer. This may give a remarkable character to the mass, causing it to appear and disappear, lifting the abdominal wall in the epigastric region; and, fourthly, mechanical movements, with inflation, with change of posture, or communicated with the hand. Tumors of the pylorus are the most movable, and in extreme cases can be displaced to either hypochondrium or pushed far down below the navel (see illustrative cases in my Lectures on the Diagnosis of Abdominal Tumors). Pain on palpation is common; the mass is usually hard, sometimes nodular. Gas can at times be felt gurgling through the tumor at the pyloric region.

Percussion gives less important indications—the note over a tumor is rarely flat, more often a flat tympany. *Auscultation* may reveal the gurgling through the pylorus; sometimes a systolic bruit is transmitted from the aorta, and when a local peritonitis exists a friction may be heard.

Complications.—*Secondary growths* are common. In 44 autopsies in our series there were metastases in 38; in 29 the lymph-glands were involved; in 23 the liver, in 11 the peritoneum, in 8 the pancreas, in 8 the bowel, in 4 the lung, in 3 the pleura, in 4 the kidneys, and in 2 the spleen. In 8 no deposits were found.

Perforation may lead to peritonitis, but in 3 of our 4 cases there was no general involvement. Cancerous ascites is not very uncommon. Dock has called attention to the value of the examination of the fluid in such cases as a help to diagnosis. The cells show mitoses and are very characteristic. Secondary cancer of the *liver* is very common; the enlargement may be very great, and such cases are not infrequently mistaken for primary cancer of the organ. Involvement of the *lymph-glands* may give valuable indications. There may be early enlargement of a gland at the posterior border of the left sterno-cleido-mastoid muscle; later adjacent glands may become affected. This occurs also in uterine cancer.

A very remarkable picture is presented when the cancer *sloughs* or becomes gangrenous; the vomitus has a foul odor, often of a penetrating nature,

to be perceived throughout the room. In cases in which the ulcer perforates the colon the vomiting may be fæcal. I have, however, met with the fæcal odor in a case with incessant vomiting in which there was no perforation of the colon at autopsy.

Course.—While usually *chronic* and lasting from a year to eighteen months, *acute* cancer of the stomach is by no means infrequent. Of the 69 cases in which we could determine accurately the duration, 15 lasted under three months, 16 from three to six months, 14 from six to twelve months—a total of 45 under one year. Four cases lasted for two years or over. One case lived for at least two years and a half.

Diagnosis.—In 115 of our 150 cases a tumor existed, and with this the recognition is rarely in doubt. The chief difficulty is in cases with gastric symptoms or anæmia, or both, without the presence of tumor. In the one a chronic gastritis is suspected; in the other a primary anæmia. In *chronic gastritis* the history of long-standing dyspepsia, the absence of cachexia, the absence of lactic acid in the test meal, and the less striking blood changes are the important points for consideration. The cases with grave *anæmia* without tumor offer the greatest difficulty. The blood-count is rarely so low as in pernicious anæmia, a point on which F. P. Henry has laid special stress. In only 8 of our 59 cases with careful blood examination was the number below 2,000,000 per c. mm. The lower color index, as in secondary anæmia, the absence of megaloblasts, and a leucocytosis speak for cancer. With metastases in the bone marrow the blood picture may be that of pernicious anæmia (Harrington and Teacher). Some lay stress on the differential count of the leucocytes, but there is not evidence enough to enable us to speak positively on this point. The chemical findings are of greater value. From a recent careful study at the London Hospital Panton and Tidy conclude that in carcinoma the Günsberg reaction is always negative and the average total acidity is 26, while in ulcer the reaction is positive, the average free hydrochloric acid is above normal, and the total acidity 58.

From *ulcer of the stomach* malignant disease is, as a rule, readily recognized. The *ulcus carcinomatosum* usually presents a well-marked history of ulcer for years. The greatest difficulty is offered when there is ulcer with tumor due to cicatricial contraction about the pylorus. In 3 such cases we mistook the mass for cancer, and even at operation it may (as in one of them) be impossible to say whether a neoplasm is present. The persistent hyperchlorhydria is the most important single feature of ulcer, and, taken with the gastralgic attacks and the hæmorrhages, rarely leaves doubt as to the condition. The X-rays are sometimes an aid.

Nowadays, when exploratory laparotomy may be advised with such safety, the surgeon often makes the diagnosis.

The practitioner should recognize the fact that there are cases of cancer of the stomach in which a positive diagnosis can not be reached for weeks or months by any known means at our command except exploration.

Treatment.—In early surgical treatment lies the only hope, but there is great difficulty in the diagnosis. Operated upon early, complete removal is sometimes possible. In a majority of cases the operation is only palliative. In suitable cases early exploration should be advised; the operation *per se* is sometimes beneficial and the patient is rarely the worse for it. To January

27th, 1910, 627 cases were operated upon at the Mayo clinic, of which 206 were in a hopeless condition. In 169 gastrostomy was performed, in 266 a tumor was resected, and among these there were 34 deaths. The after-results are given as far as possible: in 39 cases whose condition was known, who had been operated upon over 5 years before, 7 were alive; of 64, condition known, over 4 years, 13 alive; of 88, condition known, over 3 years, 18 alive and well.

The diet should consist of readily digested substances of all sorts. Many patients do best on milk alone. Washing out the stomach, which may be done with a soft tube without any risk, is particularly advantageous when there is obstruction at the pylorus, and is by far the most satisfactory means of combating the vomiting. The excessive fermentation is also best treated by lavage. When the pain becomes severe, particularly if it disturbs the rest at night, morphia must be given. One-eighth of a grain, combined with carbonate of soda (gr. v), bismuth (gr. v-x), usually gives prompt relief, and the dose does not always require to be increased. Creasote (♏ j-ij) and carbolic acid are very useful. The bleeding in gastric cancer is rarely amenable to treatment.

Other Forms of Tumor.—*Non-cancerous tumors* of the stomach rarely cause inconvenience. *Polypi* (polyadenomata) are common and they may be numerous; as many as 150 have been reported in one case. There is a form in which the adenoma exists as an extensive area slightly raised above the level of the mucosa—*polyadénome en nappe* of the French. An extraordinary multiple adenoma associated with multiple tumors throughout the intestines and subcutaneous hæmangio-endotheliomata has been described by Winternitz. H. B. Anderson has described a case of remarkable multiple *cysts* in the walls of the stomach and small intestine. *Sarcomata* are very rare. *Fibromata* and *lipomata* have been described. External polypoid tumors, myo- or fibro-sarcomata may grow from the peritoneal surface, usually the posterior, of which Sherran has collected 18 cases.

Foreign bodies occasionally produce remarkable tumors of the stomach. The most extraordinary is the *hair tumor*, of which there are many cases in the literature. The cases occur in hysterical women who have been in the habit of eating their own hair. A specimen in the medical museum of McGill University is in two sections, which form an exact mold of the stomach. The tumors are large, very puzzling, and are usually mistaken for cancer. Of 7 cases operated upon, 6 recovered; in 9 cases the condition was found post mortem (Schulten).

VII. HYPERTROPHIC STENOSIS OF THE PYLORUS

In Adults.—Microscopically, the condition is found to be very largely hypertrophy of the muscularis and submucosa of the pylorus. It was well described by the older writers. The symptoms are those of dilatation of the stomach. ~~The question is whether~~ Some of these cases may ~~not really~~ be congenital, as there have been instances reported in girls as early as the twelfth and sixteenth years.

Congenital.—This remarkable affection, first recognized by Beardsley of Connecticut, has been thoroughly studied of late years by Hirschsprung, John Thomson, and others.

Etiology.—Whether congenital or not is much discussed; certainly in a majority of cases there are no symptoms at first. It is much more common in boys than in girls, and fully one-third of the cases are in first children. The causation is unknown. Two views prevail: (*a*) that it is a congenital hypertrophy, and (*b*) that in the early days of life spasm of the pylorus occurs with consecutive hypertrophy and stenosis. The association with an early acid dyspepsia is very doubtful. In any case the part played by spasm must be considerable, as the degree of obstruction varies; many patients recover permanently, and the condition of hypertrophy may exist long after the symptoms have disappeared.

Symptoms.—Vomiting of food and wasting are constantly present; the former begins, as a rule, during the second or third week, and in a few instances at birth; it occurs usually two or three times a day, or it may be much more frequent. It is often of the expulsive type; the wasting becomes extreme, there are marked constipation, great weakness, sometimes terminal diarrhœa, or a sudden fatal syncope.

Physical Signs.—These are distinctive—visible peristalsis and palpable tumor. The peristalsis is best seen after feeding, when the waves pass at intervals, in characteristic form, from left to right above the navel; two or three waves may be seen at once. The pyloric tumor may be felt as a firm, hard, freely movable body, which varies in size and consistency, and through which gas may sometimes be felt to gurgle. When in doubt the X-ray examination with bismuth may be made.

Treatment.—Whether this should be medical or surgical is under discussion, but the former appears to have given the best results. The collected statistics of Hutchinson, Heubner, Starck, and Bendix give 85 cases with 80 recoveries (Semon), while the surgical mortality is as high as 50 per cent. On the other hand, the hospital cases admitted late do badly; of 64 cases at Great Ormond Street Hospital treated medically 78 per cent. died. Careful feeding and lavage are the important measures. The bottle-fed baby may recover with a wet-nurse. Feedings of an ounce an hour with lavage morning and evening, and occasional rectal infusions or saline injections, should be given a trial before operation.

VIII. HÆMORRHAGE FROM THE STOMACH

(*Hæmatemesis*)

Etiology.—*Gastrorrhagia*, as this symptom is called, may result from many conditions, local or general. (*a*) In local disease: (1) cancer; (2) ulcer; (3) disease of the blood-vessels, such as miliary aneurisms and occasionally varicose veins; (4) acute congestion, as in gastritis, and possibly in vicarious hæmorrhage; (5) following operations in the abdomen, particularly when the omentum is wounded, erosions of the gastric mucosa may occur, from which hæmorrhage takes place. Many cases have followed operation for appendicitis. It is a very fatal complication, as it is usually associated with peritonitis (Richardson).

(*b*) Passive congestion due to obstruction in the portal system. This may

Symptoms - rarely in 1st week - usu. 2-4 weeks -
Majority on breast fed -
Tumor very persist after all symptoms gone
vomiting. 3-4 week. - not habitual - constipation - less often: peristaltic waves
vomiting. char. soon after nursing. forcible + projectile
appear and vomiting finally persistent
Visible gastric peristalsis - visible. best seen after feeding
Tumor - median 2 cm. diam x 3 cm. long. - 3 cm to right of navel
Gastric retention - definitely explicable.
misbehaves.
Diag. 1. history. 2) Repeated vomiting & gastric retention in 3rd Typh. persistent
in Tumor - 3) visible peristalsis.
Med. Tr. feeding - lavage - (twice daily) -
mistake can recover with this. do not
Surg. - Rammstedt's Operation.
Division of circular muscular layers.
after 1st month - 1 cm. thick. wait.
feeding - breast milk. 3iii-iv + water 3i-ii - 1 hr. - gradually
Surg. to best.
Rammstedt op. 61 cases
deaths 14.

	cases		well
Lit. to 06.	36	22	14
Since 05.	[illegible]	[illegible]	[illegible]

add Ref

be either (1) hepatic, as in cirrhosis of the liver, thrombosis of the portal vein, or pressure upon the portal vein by tumor, and secondarily in cases of chronic disease of the heart and lungs. (2) Splenic. Gastrorrhagia is by no means an uncommon symptom in enlarged spleen, and is explained by the intimate relations which exist between the vasa brevia and the splenic circulation.

(*c*) Toxic: (1) The poisons of the specific fevers, small-pox, measles, yellow fever; (2) poisons of unknown origin, as in acute yellow atrophy and in purpura; (3) phosphorus.

(*d*) Traumatism: (1) Mechanical injuries, such as blows and wounds, and occasionally by the stomach-tube; (2) the result of severe corrosive poisons.

(*e*) Certain constitutional diseases: (1) Hæmophilia; (2) profound anæmias, whether idiopathic or due to splenic enlargements or to malaria; (3) cholæmia.

(*f*) In certain nervous affections, particularly hysteria, and occasionally in progressive paralysis of the insane and epilepsy.

(*g*) The blood may not always come primarily from the stomach. Thus it may belong to the nose or the pharynx. In hæmoptysis some of the blood may find its way into the stomach. Again, in bleeding from the œsophagus blood may trickle into the stomach, from which it is ejected. This occurs in the case of rupture of aneurism and of the œsophageal varices. A child may draw blood with the milk from the mother's breast even in considerable quantities and then vomit it.

(*h*) Gastrostaxis.—Under this name Hale White describes cases of hæmorrhage from the stomach in young girls without any lesion of the mucosa. They are often mistaken for ulcer. He has collected 29 cases. Surgeons have taught us that the condition is by no means uncommon. At operation the blood has been seen oozing from points in the mucosa. There may be no pain or any of the ordinary features of ulcer.

(*i*) Miscellaneous causes: Aneurism of the aorta or of its branches may rupture into the stomach. There are instances in which a patient has vomited blood once without ever having a recurrence or without developing symptoms pointing to disease of the stomach.

In new-born infants hæmatemesis may occur alone or in connection with bleeding from other mucous membranes.

In medical practice, hæmorrhage from the stomach occurs most frequently in connection with cirrhosis of the liver and ulcer of the stomach.

Morbid Anatomy.—When death has occurred from the hæmatemesis there are signs of intense anæmia. The lesion is evident in cancer and in ulcer of the stomach. It is to be borne in mind that fatal hæmorrhage may come from a small miliary aneurism communicating with the surface by a pinhole perforation, or the bleeding may be due to the rupture of a submucous vein and the erosion in the mucosa may be small and readily overlooked. It may require a careful and prolonged search to avoid overlooking such lesions. In the large group associated with portal obstruction, whether due to hepatic or splenic disease, the mucosa is usually pale, smooth, and shows no trace of any lesion. In cirrhosis, fatal by hæmorrhage, one may sometimes search in vain for any focal lesion to account for the gastrorrhagia, and we must conclude that it is possible for even the most profuse bleeding to

occur by diapedesis. The stomach may be distended with blood and yet the source of the hæmorrhage be not apparent either in the stomach or in the portal system. In such cases the œsophagus should be examined, as the bleeding may come from that source. In toxic cases there are invariably hæmorrhages in the mucous membrane itself.

Symptoms.—In rare instances fatal syncope may occur without any vomiting. In a case of the kind, in which the woman had fallen over and died in a few minutes, the stomach contained between three and four pounds of blood. The sudden profuse bleedings rapidly lead to profound anæmia. When due to ulcer or cirrhosis the bleeding usually recurs for several days. Fatal hæmorrhage from the stomach is met with in ulcer, cirrhosis, enlargement of the spleen, and in instances in which an aneurism ruptures into the stomach or œsophagus. Gastrorrhagia may occur in splenic anæmia or in leukæmia before the condition has aroused attention.

The vomited blood may be fluid or clotted; it is usually dark in color, but in the basin the outer part rapidly becomes red from the action of the air. The longer blood remains in the stomach the more altered is it when ejected.

The amount of blood lost is very variable, and in the course of a day the patient may bring up three or four pounds, or even more. In a case under the care of George Ross, in the Montreal General Hospital, the patient lost during seven days ten pounds, by weight, of blood. The usual symptoms of anæmia develop rapidly, and there may be slight fever, and subsequently œdema may occur. Syncope, convulsions, and occasionally hemiplegia occur after very profuse hæmorrhage. Blindness may follow, the result either of thrombosis of the retinal arteries or veins, or an acute degeneration of the ganglion cells of the retina.

Diagnosis.—In a majority of instances there is no question as to the origin of the blood. Occasionally it is difficult, particularly if the case has not been seen during the attack. Examination of the vomit readily determines whether blood is present or not. The materials vomited may be stained by wine, the juice of strawberries, raspberries, or cranberries, which give a color very closely resembling that of fresh blood, while iron and bismuth and bile may produce the blackish color of altered blood. In such cases the microscope will show clearly the presence of the shadowy outlines of the red blood-corpuscles, and, if necessary, spectroscopic and chemical tests may be applied.

Deception is sometimes practiced by hysterical patients, who swallow and then vomit blood or colored liquids. With a little care such cases can usually be detected. The cases must be excluded in which the blood passes from the nose or pharynx, or in which infants swallow it with the milk.

There is not often difficulty in distinguishing between hæmoptysis and hæmatemesis, though the coughing and the vomiting are not infrequently combined. The following are points to be borne in mind in the diagnosis:

HÆMATEMESIS	HÆMOPTYSIS
1. Previous history points to gastric, hepatic, or splenic disease.	1. Cough or signs of some pulmonary or cardiac disease precedes, in many cases, the hæmorrhage.

2. The blood is brought up by vomiting, prior to which the patient may experience a feeling of giddiness or faintness.

3. The blood is usually clotted, mixed with particles of food, and has an acid reaction. It may be dark, grumous, and fluid.

4. Subsequent to the attack the patient passes tarry stools, and signs of disease of the abdominal viscera may be detected.

2. The blood is coughed up, and is usually preceded by a sensation of tickling in the throat. If vomiting occurs, it follows the coughing.

3. The blood is frothy, bright red in color, alkaline in reaction. If clotted, rarely in such large coagula, and muco-pus may be mixed with it.

4. The cough persists, physical signs of local disease in the chest may usually be detected, and the sputum may be blood-stained for many days.

Prognosis.—Except in the case of rupture of an aneurism or of large veins, hæmatemesis rarely proves fatal. In my experience death has followed more frequently in cases of cirrhosis and splenic enlargement than in ulcer or cancer. In ulcer it is to be remembered that in the chronic hæmorrhagic form the bleeding may recur for years. The treatment of hæmatemesis is considered under gastric ulcer.

IX. NEUROSES OF THE STOMACH

(*Nervous Dyspepsia*)

Serious functional disturbances of the stomach may occur without any discoverable anatomical basis. The cases are met with most frequently in those who have either inherited a nervous constitution or who have gradually, through indiscretions, brought about a condition of nervous prostration. Not infrequently, however, the gastric symptoms stand so far in the foreground that the general neuropathic character of the patient quite escapes notice. Sometimes the gastric manifestations have apparently a reflex origin depending on organic disturbances in remote parts of the body.

The nervous derangements of the stomach may be divided into motor, secretory, and sensory neuroses. These disturbances rarely occur singly; they are usually met with in combined forms. The clinical picture resulting from such a complex of gastric neuroses is known as *nervous dyspepsia*. As Leube has pointed out, the sensory disturbances usually play the more important part.

The sufferer from nervous dyspepsia presents a varying picture. All grades occur, from the emaciated skeleton-like patient with anorexia nervosa to the well-nourished, healthy-looking, fresh-complexioned individual whose only complaint is distress and uneasiness after eating.

Motor Neuroses.—(*a*) Hyperkinesis or Supermotility.—An increase in the normal motor activity of the stomach results in too early a discharge of the ingesta into the intestine. It is more commonly a secondary neurosis dependent upon superacidity or supersecretion of the gastric juice; but it

may occur primarily, possibly from reflex causes. The diagnosis is to be reached only by means of the stomach-tube. It gives rise to no characteristic clinical symptoms.

(*b*) Peristaltic Unrest.—This condition, as described by Kussmaul, is an extremely common and distressing symptom. Shortly after eating the peristaltic movements of the stomach are increased, and borborygmi and gurgling may be heard, even at a distance. The subjective sensations are most annoying, and it would appear as if in the hyperæsthetic condition of the nervous system the patient felt normal peristalsis, just as in these states the usual beating of the heart may be perceptible to him. A further analogy is afforded by the fact that emotion increases this peristalsis. It may extend to the intestines, particularly to the duodenum, and on palpation over this region the gurgling is most marked. The movement may be anti-peristalsis, in which the wave passes from right to left, a condition which may also extend to the intestines. There are cases on record in which colored enemata or even scybala have been discharged from the mouth.

(*c*) Nervous Eructations.—*Aerophagia.*—In this condition severe attacks of noisy eructations, following one another often in rapid succession, occur. When violent they last for hours or days. At other times they occur in paroxysms, depending often upon mental excitement. They are more commonly observed in hysterical women and neurasthenics, but also, not infrequently, in children. The hysterical nature of the affection is sometimes testified to by the occurrence, especially in children, of several instances in one household. The expelled gas in these cases is atmospheric air, which is swallowed or aspirated from without. Sometimes the whole process may be clearly observed, but in other instances the act of swallowing may be almost or quite imperceptible.

(*d*) Nervous Vomiting.—A condition which is not associated with anatomical changes in the stomach or with any state of the contents, but is due to nervous influences acting either directly or indirectly upon the centres presiding over the act of vomiting. The patients are, as a rule, women—usually brunettes—and the subject of more or less marked hysterical manifestations. A special feature of this form is the absence of the preliminary nausea and of the straining efforts of the ordinary act of vomiting. It is rather a regurgitation, and without visible effort and without gagging the mouth is filled with the contents of the stomach, which are then spat out. It comes on, as a rule, after eating, but may occur at irregular intervals. In some cases the nutrition is not impaired, a feature which may give a clew to the true nature of the disease, as there may be no other hysterical manifestation present. As noted by Tuckwell, it may occur in children, and Edsall suggests that this recurring vomiting is an acid intoxication, as in some cases acetone and diacetic acid have been found in the urine. Treatment with full doses of bicarbonate of soda every two hours has been found to relieve it. Nervous vomiting may be a very serious condition. We have had at least two fatal cases. In some instances, after persisting for weeks or months at home, the patient gets well in a few days in hospital. In other instances the course is protracted, and the cases are among the most trying we are called upon to treat.

A type of vomiting is that associated with certain diseases of the nervous

system—particularly locomotor ataxia—forming part of the gastric crises. Leyden has reported cases of primary periodic vomiting, which he regards as a neurosis.

(*e*) Rumination; Merycismus.—In this remarkable and rare condition the patients regurgitate and chew the cud like ruminants. It occurs in neurasthenic or hysterical persons, epileptics, and idiots. In some patients it is hereditary. There is an instance in which a governess taught it to two children. The habit may persist for years, and does not necessarily impair the health.

(*f*) Spasm of the Cardia.—Spasmodic, usually painful, contraction of the circular muscle fibres at the cardiac orifice may follow the introduction of a sound, hasty eating, or the taking of too hot or too cold food. It may occur in tetanus and also in hysterical and neurasthenic individuals, especially in air swallowers, in whom, if it be combined with pyloric spasm, it may result in painful gastric distention—"pneumatosis." Here the spasm may be of considerable duration. The condition is rare and practically not of much moment.

(*g*) Pyloric Spasm.—This is usually a secondary occurrence, following superacidity, supersecretion, ulcer, or the introduction into the stomach of irritating substances. The spasm often causes pain in the region of the pylorus and increased gastric peristalsis. In cases where the spasm is combined with superacidity and supersecretion marked dilatation with atony may follow. Sometimes the pylorus may be felt as an oval, hard tumor, which relaxes under the fingers as gas passes through it. It is not easy to distinguish organic stricture and pylorospasm, but Einhorn's duodenal bucket will pass the latter, and the thread next it is bile-stained.

(*h*) Atony of the Stomach.—Motor insufficiency of the stomach is generally due to injudicious feeding, to organic disease of the stomach itself, or to general wasting processes. In some otherwise normal individuals of neurotic temperaments an atony may, however, occur which possibly deserves to be classed among the neuroses. The symptoms are usually those of a moderate dilatation, and are often associated with marked sensory disturbances—feelings of weight and pressure, distention, eructations, and so forth.

Great care must be taken in the diagnosis to rule out all other possible causes.

(*i*) Insufficiency or Incontinence of the Pylorus.—This condition was described first by de Séré and later by Ebstein. It may be recognized by the rapid passing of gas from the stomach into the bowel on attempts at inflation of the former, as well as by the presence of bile and intestinal contents in the stomach. There are no distinctive clinical symptoms.

(*j*) Insufficiency of the Cardia.—This condition is only recognized by the occurrence of eructations or in rumination.

Secretory Neuroses.—(*a*) Hyperacidity; Superacidity; Hyperchlorhydria.—In nervous dyspepsia with hyperacidity of the gastric juices the symptoms depend upon the secretion of an abnormally acid gastric juice at the time of digestion. This is a common form of dyspepsia in young and neurotic individuals, and in chlorotic girls. The symptoms are very variable. They do not, as a rule, immediately follow the ingestion of food, but occur one to three hours later, at the height of digestion. There is a sense of

weight and pressure, sometimes of burning in the epigastrium, commonly associated with acid eructations. If vomiting occurs, the pain is relieved. The patient is usually relatively well nourished, and the appetite is often good, though the sufferer may be afraid to eat on account of the anticipated pain. Its association with ulcer has been referred to. There is commonly constipation.

(*b*) Supersecretion, Intermittent and Continuous.—This is a form of dyspepsia which has been long recognized, but specially studied by Reichmann and others. The increased flow of the gastric juice may be intermittent or continuous. The secretion under such circumstances is usually superacid, though this is not always the case. The periodical form—the *gastroxynsis* of Rossbach—may be quite independent of the time of digestion. Great quantities of highly acid gastric juice may be secreted in a very small space of time. Such cases are rare, and are especially associated either with profound neurasthenia or with locomotor ataxia. The attack may last for several days. It usually sets in with a gnawing, unpleasant sensation in the stomach, severe headache, and shortly after the patient vomits a clear, watery secretion of such acidity that the throat is irritated and made raw and sore. As mentioned, the attacks may be quite independent of food. *Continuous supersecretion* is more common. The constant presence of fluid in the stomach, together with the pyloric spasm, which commonly results from the irritation of the overacid gastric juice, are followed by a more or less extensive dilatation. Digestion of the starches is retarded, and there are eructations of acid fluid and gastric distress. This secretion of highly acid gastric juice may continue when the stomach is free from food. In these cases pain, burning acid eructations, and even vomiting, occurring during the night and early in the morning, are rather characteristic.

(*c*) Nervous Subacidity or Anacidity; Achylia Gastrica Nervosa.—Lack of the normal amount of acid is found in chronic catarrh, and particularly in cancer. As Leube has shown, a reduction in the normal amount of acid may exist with the most pronounced symptoms of nervous dyspepsia and yet the stomach will be free from food within the regular time. A condition in which free acid is absent in the gastric juice may occur in cancer, in extreme sclerosis of the mucous membrane, as a nervous manifestation, and occasionally in tabes. In most of these cases, though there be no free acid, yet the other digestive ferments—pepsin and the curdling ferments—or their zymogens are to be demonstrated in the gastric juice. There may, however, be a complete absence of the gastric secretion. To these cases Einhorn has given the name of *achylia gastrica*. This condition was at first thought to occur only in cases of total atrophy of the gastric mucosa, but recent observations have shown that it may occur as a neurosis. In a case of Einhorn's the gastric secretions returned after five years of total *achylia gastrica*.

The symptoms of subacidity, or even of *achylia gastrica*, vary greatly in intensity; they may be almost or quite absent in cases of advanced atrophy of the mucosa, and, as a rule, are not marked so long as the motor activity of the stomach remains good. If atony, however, occurs and abnormal fermentative processes arise, severe gastric and intestinal symptoms may follow. In the cases associated with hysteria and neurasthenia, even though the food may be well taken care of by the intestines, there are very commonly grave

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sensory disturbances in the region of the stomach, in addition to the general nervous symptoms.

Sensory Neuroses.—(*a*) Hyperæsthesia.—In this condition the patients complain of fullness, pressure, weight, burning, and so forth, during digestion, just such symptoms as accompany a variety of organic diseases of the stomach, and yet in all other respects the gastric functions appear quite normal. Sometimes these distressing sensations are present even when the stomach is empty. These symptoms are usually associated with other manifestations of hysteria and neurasthenia. The pain often follows particular articles of food. An hysterical patient may apparently suffer excruciating pain after taking the smallest amount of food of any sort, while anything prescribed as a medicine may be well borne. In severe cases the patient may be reduced to an extreme degree by starvation.

(*b*) Gastralgia; Gastrodynia.—Severe pains in the epigastrium, paroxysmal in character, occur (1) as a manifestation of a functional neurosis, independent of organic disease, and usually associated with other nervous symptoms (it is this form which will here be described); (2) in chronic disease of the nervous system, forming the so-called gastric crises; and (3) in organic disease of the stomach, such as ulcer or cancer.

The functional neurosis occurs chiefly in women, very commonly in connection with disturbed menstrual function or with pronounced nervous symptoms. The affection may set in as early as puberty, but it is more common at the menopause. Anæmic, constipated women who have worries and anxieties at home are most prone to the affection. It is more frequent in brunettes than in blondes. Attacks of it sometimes occur in robust, healthy men. More often it is only one feature in a condition of general neurasthenia or a manifestation of that form of nervous dyspepsia in which the gastric juice or hydrochloric acid is secreted in excess. I am very skeptical as to the existence of a gastralgia of purely malarial origin.

The *symptoms* are very characteristic; the patient is suddenly seized with severe pains in the epigastrium, which pass toward the back and around the lower ribs. The attack is usually independent of the taking of food, and may recur at definite intervals, a periodicity which has given rise to the supposition in some cases that the affection is due to malaria. The most marked periodicity, however, may be in the gastralgic attacks of ulcer. They frequently come on at night. Vomiting is rare; more commonly the taking of food relieves the pain. To this, however, there are striking exceptions. Pressure upon the epigastrium commonly gives relief, but deep pressure may be painful. It seems scarcely necessary to separate the forms, as some have done, into irritative and depressive, as the cases insensibly merge into each other. Stress has been laid upon the occurrence of painful points, but they are so common in neurasthenia that very little importance can be attributed to them.

The *diagnosis* offers many difficulties. Organic disease either of the stomach or of the nervous system, particularly the gastric crises of locomotor ataxia, must be excluded. In the case of ulcer or cancer this is not always easy. The fact that the pain is most marked when the stomach is empty and is relieved by the taking of food is sometimes regarded as pathognomonic of simple gastralgia, but to this there are many exceptions, and in ulcer the

pains may be relieved on eating. The prolonged intervals between the attacks and their independence of diet are important features in simple gastralgia; but in many instances it is less the local than the general symptoms of the case which enable us to make the diagnosis. In gall-stone colic jaundice is frequently absent, and in any long-standing case of gastralgia, in which the attacks recur at intervals for years, the question of cholelithiasis should be considered. There may be hyperacidity associated with gastric atony. Such a case may be treated for months as one of nervous dyspepsia until a more severe attack than usual is followed by jaundice.

(*c*) Anomalies of the Sense of Hunger and Repletion; Bulimia.—Abnormally excessive hunger coming on often in paroxysmal attacks, which cause the patient to commit extraordinary excesses in eating. This condition may occur in diabetes mellitus and sometimes in gastric disorders, particularly those associated with supersecretion. It is, however, more commonly seen in hysteria and in psychoses. It may occur in cerebral tumors, in Graves' disease, and in epilepsy.

The attacks often begin suddenly at night, the patient waking with a feeling of faintness and pain, and an uncontrollable desire for food. Sometimes such attacks occur immediately after a large meal. The attack may be relieved by a small amount of food, while at other times enormous quantities may be taken. In obstinate cases gastritis, atony, and dilatation frequently result from the abuse of the stomach.

Akoria.—An absence of the sense of satiety. This condition is commonly associated with bulimia and polyphagia, but not always. The patient always feels "empty." There are usually other well-marked manifestations of hysteria or neurasthenia.

Anorexia Nervosa.—This condition, which is a manifestation of a neurotic temperament, is discussed subsequently under the general heading of Hysteria.

Treatment of Neuroses of the Stomach.—The most important part of the treatment of nervous dyspepsia is often that directed toward the improvement of the general physical and mental condition of the patient. The possibility that the symptoms may be of reflex origin should be borne in mind. The possibility of eye-strain, cholelithiasis, or chronic appendicitis should be considered. A large proportion of cases of nervous dyspepsia are dependent upon mental and physical exhaustion or worry, and a vacation or a change of scene will often accomplish what years of treatment at home have failed to do. The manner of life of the patient should be investigated and a proper amount of physical exercise in the open air and systematic hydrotherapy insisted upon. This alone will in some cases be sufficient to cause the disappearance of the symptoms.

Many cases of nervous dyspepsia with marked neurasthenic or hysterical symptoms do well on the Weir Mitchell treatment, and in obstinate forms it should be given a thorough trial. The most striking results are perhaps seen in the case of anorexia nervosa, which will be referred to subsequently. It is also of value in nervous vomiting.

In *cardiac spasm* care should be taken to eat slowly, to avoid swallowing too large morsels or irritating substances. The methodical introduction of thick sounds may be of value.

The treatment in *atony* of the stomach should be similar to that adopted in moderate dilatation—the administration of small quantities of food at frequent intervals; the limitation of the fluids, which should also be taken in small amounts at a time; lavage. Strychnine in full doses may be of value.

In the distressing cases of *hyperacidity,* in addition to the treatment of the general neurotic condition, alkalies must be employed either in the form of magnesia or bicarbonate of soda. These should be given in large doses and at the *height of digestion.* The burning acid eructations may be relieved in this way. In hyperacidity and hypersecretion the use of atropine frequently gives relief. It should be given before food and in small doses at first, beginning with 1/150 grain (0.0004 gm.) and gradually increasing. The combination of bromide and codeia is sometimes useful. The diet should be mainly albuminous, and should be administered in a non-irritating form. Stimulating condiments and alcohol should be avoided. Starches should be sparingly allowed, and only in most digestible forms. Fats are fairly well borne.

Limiting the patient to a strictly meat diet is a valuable procedure in many cases of dyspepsia associated with hyperacidity. The meat should be taken either raw or, if an insuperable objection exists to this, very slightly cooked. It is best given finely minced or grated on stale bread. An ample dietary is 3¼ ounces (100 grams) of meat, two medium slices of stale bread, and an ounce (30 grams) of butter. This may be taken three times a day with a glass of Apollinaris water, soda water, or, what is just as satisfactory, spring water. The fluid should not be taken too cold. The use of fats, as cream, butter, and olive oil, is often of value. Special care should be taken in the examination of the meat to guard against tape-worm infection, but suitable instructions on this point can be given. This is sufficient for an adult man, and many obstinate cases yield satisfactorily to a month or six weeks of this treatment, after which time the less readily digested articles of food may be gradually added to the dietary.

In *supersecretion* the use of the stomach-tube is of the greatest value. In the periodical form it should be used as soon as the attack begins. The stomach may be washed with alkaline solutions or solutions of nitrate of silver, 1 to 1,000, may be used. Where this is impracticable the taking of albuminous food may give relief. One of my patients used to have by his bedside two hard-boiled eggs, by the eating of which nocturnal attacks were alleviated. Alkalies in large doses are also indicated.

In cases of *continued supersecretion* there are usually atony and dilatation. The diet here should be much as in superacidity, but should be administered in smaller quantities at frequent intervals. Lavage with alkaline solutions or with nitrate of silver is of great value. To relieve pain large quantities of bicarbonate of soda or magnesia should be given at the height of digestion.

In *subacidity* a carefully regulated, easily digestible mixed diet, not too rich in albuminoids, is advisable. Bitter tonics before meals are sometimes of value. In *achylia gastrica* the use of predigested foods and of hydrochloric acid in full doses may be of assistance.

In marked *hyperæsthesia,* beside the treatment of the general condition,

nitrate of silver in doses of gr. ¼-½ (0.016 to 0.032 gm.), taken in three or four ounces of water on an empty stomach, is advised by Rosenheim. In some instances rectal feeding may have to be resorted to.

For pain large doses of alkalies should be given, of which the light magnesia and bicarbonate of soda are the best. A teaspoonful of either or of a mixture of equal parts may be given after food and when required. A combination of potassium bromide (gr. xv, 1 gm.) with codeia (gr. 1/3, 0.02 gm.) is sometimes useful. Opium is rarely necessary, but, if used, should be given by mouth.

Chloroform in small doses or Hoffman's anodyne will sometimes allay the severe pains. The general condition should receive careful attention, and in many cases the attacks recur until the health is restored by change of air with the prolonged use of arsenic. If there is anæmia iron may be given freely. Nitrate of silver in doses of gr. ¼ to ½ in a large claret-glass of water taken on an empty stomach is useful in some cases.

There are forms of nervous dyspepsia occurring in women who are often well nourished and with a good color, yet who suffer—particularly at night—with flatulency and abdominal distress. The sleep may be quiet and undisturbed for two or three hours, after which they are aroused with painful sensations in the abdomen and eructations. The appetite and digestion may appear to be normal. Constipation is, however, usually present. In many of these patients the condition seems rather intestinal dyspepsia, and the distress is due to the accumulation of gases, the result of excessive putrefaction. The fats, starches, and sugars should be restricted. A diastase ferment is sometimes useful. The flatulency may be treated by the methods above mentioned. Naphthalin, salicylate of bismuth, and salol have been recommended. Some of these cases obtain relief from thorough irrigation of the colon at bedtime.

In all forms of gastric neurosis special care should be taken to prevent constipation.

G. DISEASES OF THE INTESTINES

I. DISEASES OF THE INTESTINES ASSOCIATED WITH DIARRHŒA

CATARRHAL ENTERITIS; DIARRHŒA

In the classification of catarrhal enteritis the anatomical divisions of the bowel have been too closely followed, and a duodenitis, jejunitis, ileitis, typhlitis, colitis, and proctitis have been recognized; whereas in a majority of cases the entire intestinal tract, to a greater or lesser extent, is involved, sometimes the small most intensely, sometimes the large bowel; but during life it may be quite impossible to say which portion is specially affected.

Etiology.—The causes may be either *primary* or *secondary*. Among the causes of *primary* catarrhal enteritis are: (*a*) Improper food, one of the most frequent, especially in children, in whom it follows overeating, or the ingestion of unripe fruit. In some individuals special articles of diet will

always produce a slight diarrhœa, which may not be due to a catarrh of the mucosa, but to increased peristalsis induced by the offending material. (*b*) Various toxic substances. Many of the organic poisons, such as those produced in the decomposition of milk and articles of food, excite the most intense intestinal catarrh. Certain inorganic substances, as arsenic and mercury, act in the same way. (*c*) Changes in the weather. A fall in the temperature of from twenty to thirty degrees, particularly in the spring or autumn, may induce—how, it is difficult to say—an acute diarrhœa. We speak of this as a catarrhal process, the result of cold or of chill. On the other hand, the diarrhœal diseases of children are associated in a very special way with the excessive heat of summer months. (*d*) Changes in the constitution of the intestinal secretions. We know too little about the *succus entericus* to be able to speak of influences induced by change in its quantity or quality. It has long been held that an increase in the amount of bile poured into the bowel might excite a diarrhœa; hence the term bilious diarrhœa, so frequently used by the older writers. Possibly there are conditions in which an excessive amount of bile is poured into the intestine, increasing the peristalsis, and hurrying on the contents; but the opposite state, a scanty secretion, by favoring the natural fermentative processes, much more commonly causes an intestinal catarrh. Absence of the pancreatic secretion from the intestine ~~has been~~ associated in certain cases with a fatty diarrhœa. (*e*) Nervous influences. It is by no means clear how mental states act upon the bowels, and yet it is an old ~~and trustworthy~~ observation, which every-day experience confirms, that the mental state may profoundly affect the intestinal canal. These influences should not properly be considered under catarrhal processes, as they result simply from increased peristalsis or increased secretion, and are usually described under the heading *nervous diarrhœa*. In children it frequently follows fright. It is common ~~too~~ in adults as a result of emotional disturbances. Canstatt mentions a surgeon who always, before an important operation, had watery diarrhœa. In hysterical women it is seen as an occasional occurrence, due to transient excitement, or as a chronic, protracted diarrhœa, which may last for months or even years.

Among the *secondary* causes of intestinal catarrh may be mentioned: (*a*) Infectious diseases. Dysentery, cholera, typhoid fever, pyæmia, septicæmia, tuberculosis, and pneumonia are occasionally associated with intestinal catarrh. In dysentery and typhoid fever the ulceration is in part responsible for the catarrhal condition, but in cholera it is probably a direct influence of the bacilli or of the toxic materials produced by them. (*b*) The extension of inflammatory processes from adjacent parts. Thus, in peritonitis, catarrhal swelling and increased secretion are always present in the mucosa. In cases of invagination, hernia, tuberculosis, or cancerous ulceration catarrhal processes are common. (*c*) Circulatory disturbances cause a catarrhal enteritis, usually of a very chronic character. This is common in diseases of the liver, such as cirrhosis, and in chronic affections of the heart and lungs—all conditions, in fact, which produce engorgement of the terminal branches of the portal vessels. (*d*) In the cachectic conditions met with in cancer, profound anæmia, Addison's disease, and ~~Bright's disease~~ nephritis intestinal catarrh may occur as a terminal event.

Morbid Anatomy.—It is rare to see the mucous membrane injected; more commonly it is pale and covered with mucus. In the upper part of the small intestine the tips of the valvulæ conniventes may be deeply injected. Even in extreme grades of portal obstruction intense hyperæmia is not often seen. The entire mucosa may be softened and infiltrated, the lining epithelium swollen, or even shed, and appearing as large flakes among the intestinal contents. This is, no doubt, a post mortem change. The lymph follicles are almost always swollen, particularly in children. The Peyer's patches may be prominent and the solitary follicles in the large and small bowel may stand out with distinctness and present in the centres little erosions, the so-called follicular ulcers. This may be a striking feature in the intestine in all forms of catarrhal enteritis in children, quite irrespective of the intensity of the diarrhœa.

When the process is more chronic the mucosa is firmer, in some instances thickened, in others distinctly thinned, and the villi and follicles present a slaty pigmentation.

Symptoms.—Acute and chronic forms may be recognized. The important symptom of both is diarrhœa, which, in the majority of instances, is the sole indication of this condition. It is not to be supposed that diarrhœa is invariably caused by, or associated with, catarrhal enteritis, as it may be produced by nervous and other influences. It is probable that catarrh of the jejunum may exist without any diarrhœa; indeed, it is a very common circumstance to find post mortem a catarrhal state of the small bowel in persons who have not had diarrhœa during life. The stools vary extremely in character. The color depends upon the amount of bile with which they are mixed, and they may be of a dark or blackish brown, or of a light yellow, or even of a grayish-white tint. The consistence is usually very thin and watery, but in some instances the stools are pultaceous like thin gruel. Portions of undigested food can often be seen (lienteric diarrhœa), and flakes of yellowish-brown mucus. Microscopically there are innumerable micro-organisms, epithelium and mucous cells, crystals of phosphate of lime, oxalate of lime, and occasionally cholesterin and Charcot's crystals.

Pain in the abdomen is usually present in the acute ~~catarrhal~~ enteritis, particularly when due to food. It is of a colicky character, and when the colon is involved there may be tenesmus. More or less tympanites exists, and there are gurgling noises, ~~or borborygmi~~, due to the rapid passage of fluid and gas from one part to another. In the very acute attacks there may be vomiting. Fever is not, as a rule, present, but there may be a slight elevation of one or two degrees. The appetite is lost, there is intense thirst, and the tongue is dry and coated. In very acute cases, when the quantity of fluid lost is great and the pain excessive, there may be collapse symptoms. The number of evacuations varies from four or five to twenty or more in the course of the day. The attack lasts for two or three days, or may be prolonged for a week or ten days.

Chronic catarrh of the bowels may follow the acute form, or may come on gradually as an independent affection or as a sequence of obstruction in the portal circulation. It is characterized by diarrhœa, with or without colic. The dejections vary; when the small bowel is chiefly involved the diarrhœa is of a lienteric character, and when the colon is affected the stools are thin

[illegible]

[illegible]

appears to be a species of Menilia – See Ann. Soc. Espan.

and mixed with much mucus. A special form of mucous diarrhœa will be subsequently described. The general nutrition in these chronic cases is greatly disturbed; there may be much loss of flesh and great pallor. The patients are inclined to suffer from low spirits, or hypochondriasis may develop.

Diagnosis.—It is important, in the first place, to determine, if possible, whether the large or small bowel is chiefly affected. In catarrh of the small bowel the diarrhœa is less marked, the pains are of a colicky character, borborygmi are not so frequent, the fæces usually contain portions of food, and are more yellowish-green or grayish-yellow and flocculent and do not contain much mucus. When the large intestine is at fault there may be no pain whatever, as in the catarrh of the large intestine associated with tuberculosis and Bright's disease. When present, the pains are most intense, and, if the lower portion of the bowel is involved, there may be marked tenesmus. The stools have a uniform soupy consistence; they are grayish in color and granular throughout, with here and there flakes of mucus, or they may contain very large quantities of mucus.

There are no positive symptoms by which the diagnosis of duodenitis can be made. It is usually associated with acute gastritis and, if the process extends into the bile-duct, with jaundice. Neither jejunitis nor ileitis can be separated from general intestinal catarrh.

The Cœliac Affection.—Under this heading Gee has described an intestinal disorder, most commonly met with in children between the ages of one and five, characterized by the occurrence of pale, loose stools, not unlike gruel or oatmeal porridge. They are bulky, not watery, yeasty, frothy, and extremely offensive. The affection has received various names, such as *diarrhœa alba* or *diarrhœa chylosa*. It is not associated with tuberculosis or other hereditary disease. It begins insidiously and there are progressive wasting, weakness, and pallor. The belly becomes doughy and inelastic. There is often flatulency. Fever is usually absent. The disease is lingering and a fatal termination is common. So far nothing is known of the pathology of the disease. Ulceration of the intestines has been met with, but it is not constant.

Sprue or Psilosis.—A remarkable disease of the tropics, characterized by "a peculiar, inflamed, superficially ulcerated, exceedingly sensitive condition of the mucous membrane of the tongue and mouth; great wasting and anæmia; pale, copious, and often loose, frequent, and frothy fermenting stools; very generally by more or less diarrhœa; and also by a marked tendency to relapse" (Manson). It is very prevalent in India, China, and Java. Nothing definite is known as to its cause.

When fully established the chief symptoms are a disturbed condition of the bowels, pale, yeasty-looking stools, a raw, bare, sore condition of the tongue, mouth, and gullet, sometimes with actual superficial ulceration. With these gastro-intestinal symptoms there are associated anæmia and general wasting. It is very chronic with numerous relapses. There are no characteristic anatomical changes. There are usually ulcers in the colon, and the French think it is a form of dysentery.

Manson recommends rest and a milk diet as curative in a large proportion of the cases. The monograph by Thin and the article by Manson in Allbutt and Rolleston's System give very full descriptions of the disease.

DIPHTHEROID OR CROUPOUS ENTERITIS

A croupous or diphtheroid inflammation of the mucosa of the small and large intestines occurs (*a*) most frequently as a secondary process in the infectious diseases—pneumonia, pyæmia in its various forms, and typhoid fever; (*b*) as a terminal process in many chronic affections, such as ~~Bright's~~ disease, cirrhosis of the liver, or cancer; and (*c*) as an effect of certain poisons —mercury, lead, and arsenic.

There are three different anatomical pictures. In one group of cases the mucosa presents on the top of the folds a thin grayish-yellow diphtheroid exudate situated upon a deeply congested base. In some cases all grades may be seen between the thinnest film of superficial necrosis and involvement of the entire thickness of the mucosa. In the colon similar transversely arranged areas of necrosis are seen situated upon hyperæmic patches, and it may be here much more extensive and involve a large portion of the membrane. There may be most extensive inflammation without any involvement of the solitary follicles of the large or small bowel.

In a second group ~~of cases~~ the membrane has rather a croupous character. It is grayish-white in color, more flake-like and extensive, limited, perhaps, to the cæcum or to a portion of the colon; thus, in several cases of pneumonia I found this flaky adherent false membrane, in one instance forming patches 1 to 2 cm. in diameter, which in form were not unlike rupia crusts.

In a third group the affection is really a follicular enteritis, involving the solitary glands, which are swollen and capped with an area of diphtheroid necrosis or are in a state of suppuration. Follicular ulcers are common in this form. The disease may run its course without any symptoms, and the condition is unexpectedly met with post mortem. In other instances there are diarrhœa, pain, but not often tenesmus or the passage of blood-stained mucus. In the toxic cases the intestinal symptoms may be very marked, but in the terminal colitis of the fevers and of constitutional affections the symptoms are often trifling.

The ulcerative colitis of chronic disease may be only a terminal event in these diphtheroid processes.

PHLEGMONOUS ENTERITIS

As an independent affection this is excessively rare, even less frequent than its counterpart in the stomach. It is seen occasionally in connection with intussusception, strangulated hernia, and chronic obstruction. Apart from these conditions it occurs most frequently in the duodenum, and leads to suppuration in the submucosa and abscess formation. Except when associated with hernia or intussusception the affection can not be diagnosed. The symptoms usually resemble those of peritonitis.

ULCERATIVE ENTERITIS

In addition to the specific ulcers of tuberculosis, syphilis, and typhoid fever, the following forms of ulceration occur in the bowels:

Follicular Ulceration.—As previously mentioned, this is met with very commonly in the diarrhœal diseases of children, and also in the secondary or terminal inflammations in many fevers and constitutional disorders. The ulcers are small, punched out, with sharply cut edges, and they are usually limited to the follicles. With this form may be placed the catarrhal ulcers of some writers.

Stercoral ulcers, which occur in long-standing cases of constipation. Very remarkable indeed are the cases in which the sacculi of the colon become filled with rounded small scybala, some of which produce distinct ulcers in the mucous membrane. The fæcal masses may have lime salts deposited in them, and thus form little enteroliths.

Simple Ulcerative Colitis.—Simple idiopathic or innominate ulcerative colitis has been differentiated from amœbic and bacillary dysentery by Hale White and others. It is a disease of adults, of unknown origin. The sexes are equally affected; of 177 cases collected by Eric Smith, 89 were in males. Some patients have had previous bowel trouble; sometimes there have been intermittent attacks of diarrhœa and constipation. When established, the main features are:

(*a*) Diarrhœa: the motions very frequent in the day, up to 20 or 30, usually small, bile-stained, with mucus and blood, sometimes mixed with the motion or separate. There may be clotted lumps of blood, or the blood is uniformly mixed, and the motions look like anchovy sauce. The pain, while severe, is usually diffuse, abdominal, and colicky, and, not so frequently, in the rectum. Many of the motions pass without pain.

(*b*) Fever, which occurs in the majority of the cases, though severe forms may be free throughout.

(*c*) Wasting, debility, and progressive anæmia.

The disease may run a very acute course, but most frequently it is chronic, lasting from eight weeks to three or four months. Transient improvement may follow, and a relapse. Death is most commonly from exhaustion, occasionally from hæmorrhage, and in a few instances from perforation. Post mortem, the colon is dilated, often without hypertrophied walls; the ulceration, as a rule, limited to it and very extensive, the ulcers ranging in size from a pin's head to large areas, with infiltrated, rarely undermined, edges. The Shiga bacillus is not present; the colon bacilli are found in various forms, but no one organism has apparently any definite relation to the disease.

Ulceration from External Perforation.—This may result from the erosion of new growths or, more commonly, from localized peritonitis with abscess formation and perforation of the bowel. This is met with most frequently in tuberculous peritonitis, but it may occur in the abscess which follows perforation of the appendix or suppurative or gangrenous pancreatitis. Fatal hæmorrhage may result from the perforation.

Cancerous Ulcers.—In very rare instances of multiple cancer or sarcoma the submucous nodules break down and ulcerate. In one case the ileum contained eight or ten sarcomatous ulcers secondary to an extensive sarcoma in the neighborhood of the shoulder-joint.

Solitary Ulcer.—Occasionally a solitary ulcer is met with in the cæcum or colon, which may lead to perforation. Two instances of ulcer of the cæcum,

both with perforation, have come under my observation, and in one instance a simple ulcer of the colon perforated and led to fatal peritonitis.

Diagnosis of Intestinal Ulcers.—As a rule, diarrhœa is present in all cases, but exceptionally there may be extensive ulceration, particularly in the small bowel, without diarrhœa. Very limited ulceration in the colon may be associated with frequent stools. The character of the dejections is of great importance. Pus, shreds of tissue, and blood are the most valuable indications. Pus occurs most frequently in connection with ulcers in the large intestine, but when the bowel alone is involved the amount is rarely great, and the passage of any quantity of pure pus is an indication that it has come from without, most commonly from the rupture of a pericæcal abscess, or in women of an abscess of the broad ligament. Pus may also be present in cancer of the bowel, or it may be due to local disease in the rectum. A purulent mucus may be present in the stools in cases of ulcer, but it has not the same diagnostic value. The swollen, sago-like masses of mucus which are believed by some to indicate follicular ulceration are met with also in mucous colitis. Hæmorrhage is an important and valuable symptom of ulcer in the bowel, particularly if profuse. It occurs under so many conditions that taken alone it may not be specially significant, but with other coexisting circumstances it may be the most important indication of all.

Fragments of tissue are occasionally found in the stools in ulcer, particularly in the extensive and rapid sloughing in dysenteric processes. Definite portions of mucosa, shreds of connective tissue, and even bits of the muscular coat may be found. Pain occurs in many cases, either of a diffuse, colicky character, or sometimes, in the ulcer of the colon, very limited and well defined.

Perforation is an accident liable to happen when the ulcer extends deeply. In the small bowel it leads to a localized or general peritonitis. In the large intestine, too, a fatal peritonitis may result, or, if perforation takes place in the posterior wall of the ascending or descending colon, the production of a large abscess cavity in the retro-peritoneum.

Treatment of the Previous Conditions

Acute Dyspeptic Diarrhœa.—All solid food should be withheld. If vomiting is present ice may be given, and small quantities of milk and soda water may be taken. If the attack has followed the eating of large quantities of indigestible material, castor oil or calomel is advisable, but is not necessary if the patient has been freely purged. If the pain is severe, 20 drops (1.3 c. c.) of laudanum and a drachm (4 c. c.) of spirit of chloroform may be given, or, if the colic is very intense, a hypodermic of a quarter of a grain (0.016 gm.) of morphia. It is not well to check the diarrhœa unless it is profuse, as it usually stops spontaneously within forty-eight hours. If persistent, the aromatic chalk powder or large doses of bismuth (30 to 40 grains, 2 gm.) may be given. A small enema of starch (2 ounces, 60 c. c.), with 20 drops (1.3 c. c.) of laudanum, every six hours, is a most valuable remedy.

Chronic diarrhœa, including chronic catarrh and ulcerative enteritis. It is important, in the first place, to ascertain, if possible, the cause and whether

In rectum—blown cotton examined by tube.

always shows bacteria

Gastrogenous diarrhoea — fatal by 11th.

Rectum bad.
Negative effect vaginal. Cervix ulcerated.
Discharge caused streptococci present. Uterus examined. Vaginal discharge negative

M. Cacostomy

ulceration is present or not. So much in treatment depends upon the careful examination of the stools—as to the amount of mucus, the presence of pus, the occurrence of parasites, and, above all, the state of digestion of the food—that the practitioner should pay special attention to them. Many patients simply require rest in bed and a restricted diet. Chronic diarrhœa of many months' or even of several years' duration may be sometimes cured by strict confinement to bed and a diet of boiled milk and albumen water.

In that form in which immediately after eating there is a tendency to loose evacuations it is usually found that some one article of diet is at fault. The patient should rest for an hour or more after meals. Sometimes this alone is sufficient to prevent the occurrence of the diarrhœa. In those forms which depend upon abnormal conditions in the small intestine, either too rapid peristalsis or faulty fermentative processes, bismuth is indicated. It must be given in large doses—from half a drachm to a drachm (2 to 4 gm.) three times a day. The smaller doses are of little use. Naphthalin preparations here do much good, given in doses of from 10 to 15 grains (1 gm.) four or five times a day. Larger doses may be needed. Salol and the salicylate of bismuth may be tried.

An extremely obstinate and intractable form is the diarrhœa of hysterical women. A systematic rest cure will be found most advantageous, and if a milk diet is not well borne the patient may be fed exclusively on egg albumen. The condition seems to be associated in some cases with increased peristalsis, and in such the bromides may do good, or preparations of opium may be necessary. There are instances which prove most obstinate and resist all forms of treatment, and the patient may be greatly reduced. A change of air and surroundings may do more than medicines.

In a large group of the chronic diarrhœas the mischief is seated in the colon and is due to ulceration. Medicines by the mouth are here of little value. The stools should be carefully watched and a diet arranged which shall leave the smallest possible residue. Boiled or peptonized milk may be given, but the stools should be examined to see whether there is an excess of food or of curds. Meat is, as a rule, badly borne in these cases. The diarrhœa is best treated by enemata. The starch and laudanum should be tried, but when ulceration is present it is better to use astringent injections. From 2 to 4 pints of warm water, containing from half a drachm to a drachm (2 to 4 gm.) of nitrate of silver, may be used. In the chronic diarrhœa which follows dysentery this is particularly advantageous. In giving large injections the patient should be in the dorsal position, with the hips elevated, and it is best to allow the injection to flow in gradually from a siphon bag. In this way the entire colon can be irrigated and the patient can retain the injection for some time. The silver injections may be very painful, but they are invaluable in all forms of ulcerative colitis. Acetate of lead, boracic acid, sulphate of copper, sulphate of zinc, and salicylic acid may be used in 1 per cent. solutions. In obstinate cases appendicostomy should be done and the bowel irrigated through the opening.

In the intense forms of choleraic diarrhœa in adults associated with constant vomiting and frequent watery discharges the patient should be given at once a hypodermic of a quarter of a grain of morphia, which should be repeated in an hour if the pains return or the purging persists. This gives

prompt relief, and is often the only medicine needed in the attack. The patient should be given stimulants, and, when the vomiting is allayed by suitable remedies, small quantities of milk and lime water.

II. DIARRHŒAL DISEASES IN CHILDREN

Children are particularly susceptible to disorders of the alimentary tract. Although several forms are recognized, they so often merge the one into the other that a sharp differentiation is impossible.

General Etiology.—Certain factors predispose to diarrhœa. AGE.—The largest number of cases occur just after the nursing period; the highest mortality is in the second half of the first year, when this period falls in the hot weather; hence the dread of the "second summer."

DIET.—Diarrhœa is most frequent in artificially fed babies. Of nineteen hundred and forty-three fatal cases collected by Holt, only 3 per cent. were breast-fed. The recent agitation for pure milk in the large cities has decreased materially the number of diarrhœa cases among bottle-fed infants.

Among the poor the bowel complaint comes with artificial feeding, and is due either to milk ill-suited in quantity or poor in quality, or to indigestible articles of diet. Very many of the fatal cases have been fed upon condensed milk.

TEMPERATURE.—The relation of the atmospheric temperature to the prevalence of the disease in children has long been recognized. The mortality curve begins to rise in May, increases in June, reaching the maximum in July, and gradually sinks through August and September. The maximum corresponds closely with the highest mean temperature, yet we can not regard the heat itself as the direct agent, but only as one of several factors. Thus the mean temperature of June is only four or five degrees lower than that of July, and yet the mortality is not more than one-third. Seibert, who has carefully analyzed the mortality and the temperature month by month in New York for ten years, fails to find a constant relation between the degrees of heat and the number of cases of diarrhœa. Neither barometric pressure nor humidity appears to have any influence.

BACTERIOLOGY.—The discovery by Duvall and Bassett, working at the Thomas Wilson Sanitarium, in the dejecta of children suffering from summer diarrhœa, of a bacillus apparently identical with the organism shown by Shiga to be the cause of epidemic dysentery in Japan, has awakened renewed interest in the relation of bacteria to these disorders in children.

The Rockefeller Institute research showed that this organism was present in a large number of cases of so-called "summer diarrhœa." No instances of cholera infantum were studied. The laboratory studies of Martini and Lentz, Flexner, Hiss, Parke, and others indicate that there is a group of closely allied forms of bacilli differing slightly from the original Shiga bacillus in their action on certain sugars and in agglutinating properties.

The type of organisms most frequently associated with the diarrhœas of children belongs to the so-called "acid type," and, unlike the Shiga cultures, ferments mannite with acid production.

The causal connection of this group of bacteria with all the diarrhœal

diseases of children has not been proved. In the hands of some workers they have been found in the fæces of a large proportion of all cases examined, and also less frequently in the sporadic diarrhœas occurring throughout the year. These organisms are often found in comparatively small numbers, and are more easily isolated from mucus or blood-stained stools. They occur in the acute primary intestinal infection in children, in subacute infection without previous symptoms coincident with or following other acute diseases such as measles, pneumonia, etc., and in the terminal intestinal infection following malnutrition or marasmus. They have been found in breast-fed infants as well as bottle-babies.

The mode of entrance of the organism has not been determined. Simultaneous outbreaks of many cases in remote parts of a community where there can be no common milk supply, and occurrence of the disease in breast- and condensed-milk-fed babies, indicate that cow's milk is not the only conveyor of the infection, and point to some common cause, possibly to the water, as a means of contamination, although dysentery bacilli have not yet been isolated from city water.

The importance of other organisms must not be overlooked. The observations of Escherich showed the remarkable simplicity of bacterial flora in the intestines of healthy milk-fed children, *Bacterium lactis aerogenes* being present in the upper portion of the bowel and *Bacterium coli commune* in the lower bowel, each almost in pure culture.

When diarrhœa is set up the number and varieties of bacteria are greatly increased, although heretofore no forms had been found to bear a constant or specific relationship to the diarrhœal fæces.

Certain diarrhœas in children are apparently induced by the lactic acid organisms in milk, others by *colon* or *proteus bacilli*, and others, again, by the *pyogenic cocci* and other forms; all these bacteria may be associated with the dysentery bacilli.

There is considerable evidence to support the view that the destructive lesions of the intestines may be produced by the *Streptococcus pyogenes* after an initial infection with a member of the dysentery group.

Morbid Anatomy.—In mild cases there may be only a slight catarrhal swelling of the mucosa of both small and large bowel, with enlargement of the lymph follicles. The mucous membrane may be irregularly congested; often this is most marked at the summit of the folds. The submucosa is usually infiltrated with serum and small round cells. In more severe cases ulceration may take place. The loss of substance begins, usually, in the mucosa, over swollen lymph follicles. About the ulcer there is a more or less distinctly marked inflammatory zone. The destruction of the tissue is limited to the region of the follicles and becomes progressive by the union of several adjoining ulcers. This process is usually confined to the lower bowel, and may be so extensive as to leave only ribbons of intact mucosa. The ulcers never perforate. Rarely there is a croupous or pseudo-membranous enteritis affecting the lower ilium, colon, and rectum. The constant features are the increased secretion of mucus and the lymphoid hyperplasia. The mesenteric glands are enlarged.

The changes in the other organs are neither numerous nor characteristic. Broncho-pneumonia occurs in many cases. The liver is often fatty, the

spleen may be swollen. Brain lesions are rare; the membranes and substance are often anæmic, but meningitis or thrombosis is very uncommon.

Clinical Forms.—Acute Intestinal Indigestion.—This form occurs in children of all ages, and is associated with improper food. The symptoms often begin abruptly with nausea and vomiting, or, especially in stronger children, several hours or a day or two after the disturbing diet. The local symptoms are colicky pains, moderate tympanites, and diarrhœa. The stools are four to ten in twenty-four hours; at first fæcal, then fluid, with more or less mucus and particles from undigested material. There is no blood. The usual intestinal bacteria are found. Occasionally, when there is mucus, dysentery bacilli are present. There is always fever. It is rarely very high, and never continues. The pulse may be rapid and the prostration marked in very young or weak children. These symptoms usually subside shortly after the emptying of the bowel.

In weakened infants, or when the treatment has been delayed or the diet remains unchanged, this disturbance may lead to more serious conditions. Attacks of intestinal indigestion tend to recur.

Acute Dyspepsia, or Fermentative Diarrhœa.—This form is characterized by more severe constitutional symptoms. It may begin after an intestinal indigestion of several days in which the stools are fluid and offensive, and contain undigested food and curds. In other cases the disease sets in abruptly with vomiting, griping pains, and fever, which may rapidly reach 104°-105°F.

Nervous symptoms are usually prominent. The child is irritable and sleeps poorly. Convulsions may usher in the acute symptoms or occur later. An increasing drowsiness, ending in coma, has been noted in many cases. The stools, which vary from four to twenty in twenty-four hours, soon lose their fæcal character and become fluid. Later they consist largely of green or translucent mucus. An occasional fleck of blood is noticed in the mucus, but this is never present in large amounts.

Microscopically, besides the food residue and mucous strands are a moderate number of leucocytes and red blood-corpuscles. Epithelial cells are found with numerous bacteria.

The acute symptoms generally pass away in a few days with judicious treatment. Relapses are frequent, following any indiscretion. The attack may be the beginning of severe ileo-colitis.

These gastro-intestinal intoxications are largely confined to the summer months and form an important group of the summer diarrhœas of children.

Cholera Infantum.—This term should be reserved for the fulminating form of gastro-intestinal intoxication. The typical cases are rare and form only a very small proportion of the diarrhœal diseases of infants. The disease sets in with vomiting, which is incessant and is excited by an attempt to take food or drink. The stools are profuse and frequent; at first fæcal in character, brown or yellow in color, and finally thin, serous, and watery. The stools first passed are very offensive; subsequently they are odorless. The thin, serous stools are alkaline. There is fever, but the axillary temperature may register three or more degrees below that of the rectum. From the outset there is marked prostration; the eyes are sunken, the features pinched,

Decidunis - cummun = rapid rab. sarh
magha pubein ei mich. - or hubei pun bachein ei mich.
do ent ul- pubein - orgive veg. pubein. - dergan.
Stanvalan' undul ti zum.
Mund wake - ada biccub- [illegible]

the fontanelles depressed, and the skin has a peculiar ashy pallor. At first restless and excited, the child subsequently becomes heavy, dull, and listless. The tongue is coated at the onset, but subsequently becomes red and dry. As in all choleraic conditions, the thirst is insatiable; the pulse is rapid and feeble, and toward the end becomes irregular and imperceptible. Death may occur within twenty-four hours, with symptoms of collapse and great elevation of the internal temperature. Before the end the diarrhœa and vomiting may cease. In other instances the intense symptoms subside, but the child remains torpid and semi-comatose, with fingers clutched, and there may be convulsions. The head may be retracted and the respirations interrupted, irregular, and of the Cheyne-Stokes type. The child may remain in this condition for some days without any signs of improvement. It was to this group of symptoms in infantile diarrhœa that Marshall Hall gave the term "hydrencephaloid," or spurious hydrocephalus. As a rule, no changes in the brain or other organs are found. The condition of sclerema is described as a sequel of cholera infantum. The skin and subcutaneous tissue becomes hard and firm, and the appearance has been compared to that of a half-frozen cadaver.

No constant organism has been found in these cases. Baginsky considers the disease the result of the action on the system of the poisonous products of decomposition encouraged by the various bacteria present—a *Fäulniss* disease. The clinical picture is that produced by an acute bacterial infection, as in Asiatic cholera.

Diagnosis.—The diagnosis is readily made. There is no other intestinal affection in children for which it can be mistaken. The constant vomiting, the frequent watery discharges, the collapse symptoms, and the elevated temperature make an unmistakable clinical picture. The outlook in the majority of cases is bad, particularly in children artificially fed. Hyperpyrexia, extreme collapse, and incessant vomiting are the most serious symptoms.

Ileo-colitis (*Entero-colitis, Inflammatory Diarrhœa*).—In this form there is evidence of an inflammatory alteration of the intestinal wall, usually of the lower ileum and large intestine. Several sub-varieties are recognized according to the nature and site of the lesions. Many of the cases are grafted on the simple forms above described. The mucous discharges continue, mingled with food residue and often streaked with blood. Pus cells are numerous under the microscope. The temperature remains elevated or may be remittent. After two or three weeks the symptoms gradually subside, the stools become fewer in number, and the fæcal character returns.

In other instances the severe involvement of the intestines seems evident within a few hours of the onset, with abdominal pain, vomiting, and fever. Blood and pus may be present in nearly every stool. Tenesmus is frequent and prolapsus ani is not uncommon. In severe attacks the prostration is marked, the tongue is dry, the mouth covered with sordes, and death may ensue in a few days from profound sepsis, or, if the acute stage is survived, the patient may continue desperately ill for weeks, gradually recover, or die from asthenia.

Hæmorrhage of large amounts of blood is extremely rare. The appearance of bright red stains on the napkin indicates, usually, ulceration of the lower bowel or rectum. When the blood is dark brown the lesion is in the

ileum or near the valve. The extent of the ulceration can not be accurately determined by the quantity of the blood passed.

Membranous-colitis is usually only to be distinguished by the discovery of the membrane in the rectum through a speculum or in prolapsus, or by the passage of a fragment of the membrane in the stools.

Inflammation of the colon often occurs in marantic infants. It may consist of a catarrhal or follicular inflammation of the lower bowel without destructive lesion, and is frequently a terminal infection.

Ileo-colitis may become chronic and persist for months. The signs of active inflammation subside; there is little pain or fever, but more or less mucus remains in the stools. The general condition of the child suffers. There is a continuous loss in weight; the skin is dry and hangs in folds; nervous symptoms are always present. There may be stiffness and contraction of the extremities, with opisthotonos. The progress of the disease is irregular, marked by short periods of improvement. Death is often due to a relapse, to asthenia, or to broncho-pneumonia. In many of these cases, both acute and chronic, the dysentery bacilli have been found in association with other organisms.

Prevention.—Unquestionably, most of the intestinal disorders of children can be prevented. In many of our large cities the mortality from the summer diarrhœas has been greatly reduced by prophylactic measures.

The infant should have abundance of air-space in the home, with plenty of sunlight and fresh air. In hot weather it may be well for him to sleep out of doors, day and night. His clothing must not be too heavy in midsummer; often only a binder and thin dress. This clothing should be altered with every change of the temperature. The greatest cleanliness should surround the life of the baby, and the nursing-bottles and nipples are to be boiled each day and kept scrupulously clean. Breast-feeding is continued whenever possible.

With bottle-babies, in warm weather, the diet should be reduced in strength—i. e., weaker milk mixtures used and more water given. In all crowded communities the milk should be sterilized or pasteurized during the summer months, and all the water given the baby, either with or between the nourishment, boiled. It is better that a child should be in the country during the hot weather, but when this is impossible the various parks in our large cities afford much relief.

Treatment.—Hygienic Management.—Even after the illness has begun, much can be done by hygienic measures to diminish the severity. Change of air to seashore or mountain is often followed by a marked improvement in the child's condition. The patient must not be too warmly clad. The temperature may be lowered and nervous symptoms allayed by hydrotherapy. Baths, warm and cool, are helpful. Colon irrigations serve the double purpose of flushing the bowel and stimulating the nervous system. They should be given cool when there is much fever.

Medicinal.—In all cases of diarrhœa there are more or less congestion of the intestinal mucosa, hypersecretion of mucus, and increased peristalsis due in part to the irritant action of improper food. In certain forms toxic symptoms from the absorption of poisons from the intestinal tract are early noticed. In other instances inflammatory lesions in the wall of the bowel are

present. The keynote, then, of the treatment is promptness. Nature's effort to remove the disturbing cause should be assisted, not checked, and care must be taken to introduce food that will afford the least pabulum for the disturbing bacteria.

Castor oil and calomel are to be preferred as purgatives, especially for infants. A drachm (4 c. c.) of the former, repeated, if necessary, will usually sweep the intestinal tract and relieve the irritation. Where there is much nausea or intestinal fermentation, calomel is indicated. It may be given in divided doses at short intervals until one or two grains (0.065 or 0.13 gm.) have been taken, or until the characteristic green stools appear. Very early in the attack, if nausea is a marked symptom, nothing relieves so quickly as gastric lavage with warm water, or a weak soda solution when there is much acidity. In older children a large draught of boiled water may be substituted. In many cases irrigation of the lower bowel with large quantities of salt solution flushes the colon, removing the irritating material, and diminishes the absorption of toxins. It also reduces the temperature and allays nervous symptoms. The irrigating fluid should be cool when there is much fever. The infant is placed in the dorsal position or turned a little to the left, with hips elevated, and the fluid from a fountain syringe, about three feet above the patient, is allowed to flow into the rectum through a large soft rubber catheter. Usually about a pint can be retained before expulsion. If desired, the catheter can be gently pushed into the bowel as it becomes distended with fluid. Two or three quarts should be used at one irrigation, which may be repeated several times in twenty-four hours if it is beneficial.

Where there is ulceration of the lower bowel various astringents, such as alum, witch hazel (one or two teaspoonfuls to one quart), silver nitrate, 1-4,000, or a weak solution of permanganate of potassium, may be used as the irrigating fluid.

When there is much loss of fluid from the body or when toxic symptoms are marked infusion of normal salt solution under the skin may be tried. One to three hundred c. c. of the solution can be readily introduced. This procedure is not so permanently helpful as it was thought to be some years ago. There is rarely any necessity to transfuse.

Of the many drugs vaunted as intestinal astringents and antiseptics, bismuth, either as subgallate or subnitrate, has proven most serviceable. It should not be given until the disturbing material has been removed and the temperature is falling; then it should be administered in large doses, 5 to 10 grains (0.3 to 0.6 gm.) every hour, until there is discoloration of the stools. In some cases this may be hastened by lac sulphur in grain doses. Opium should be very sparingly used, and then only for a specific purpose, to check excessive peristalsis, violent colic, or very numerous passages. It may be given to an infant as Dover's powder, ¼-1 grain (0.016 to 0.065 gm.); or paregoric, 5-10 minims (0.3 to 0.6 c. c.) every four hours; or morphia, hypodermically, 1/200-1/50 grain (0.00032 to 0.0013 gm.), when prompt action is desired. Occasionally it is well to combine it with atropia, 1/1,000-1/250 grain. The bowels should not be locked when the stools are foul or the temperature is high.

In all cases where there is prostration stimulants are indicated. Alcohol,

such as brandy or whisky, ½ to 1 ounce in twenty-four hours in frequent doses, diluted six to ten times with water, or, where there is much nausea, champagne with cracked ice, is most helpful. Strychnine, 1/200-1/100 grain (0.0003 to 0.0006 gm.), or digitalin in similar doses, may be indicated. Camphor is also an excellent stimulant.

Serum Therapy.—Thus far the results of serum therapy have been disappointing. Of 83 cases collected during the summer of 1903 by the Rockefeller Institute, there were no cures which could be certainly ascribed to the serum, nor was the mortality, as compared with previous years, appreciably lowered by serum prepared from either the so-called acid or alkaline type of organism. In nearly all instances, however, in which the serum was given several days had elapsed after the onset of the illness. It was only in the very early cases that any improvement at all was noticed. It may be that an earlier trial will be followed by better results.

Certainly the marked reduction in the mortality in adult dysentery in Japan, reported by Shiga, should encourage the further trial of this treatment in the epidemic diarrhœa, as no ill effects whatever have been ascribed to its use. It is given in 10-40 c. c. doses, hypodermically.

Diet.—The dietetic management is of the utmost importance. In acute cases with fever the milk, whether breast or cow's milk, and all its modifications, must be stopped at once. It is best to give the infant nothing but water for several hours, it may be for two or three days, or until the acute symptoms subside; a cereal water may then be substituted, preferably dextrinized, to which may be added egg albumen, broth, or beef juice. Preparations of broth and beef juice, and occasionally a weak tea, may be given. The time at which it is safe to return to a milk diet varies with each case, and no definite rules can be laid down. It is usually better to defer milk until the temperature is nearly normal.

If the stools are offensive from proteid decomposition, a diet consisting largely of carbohydrates—i. e., barley water—is indicated; whereas proteid diet, such as beef juice and egg albumen, is more helpful when the stools are strongly acid.

Experience has shown that the ingredient in the milk that is not well borne is the fat; hence skimmed milk, diluted or partially digested, can often be safely given before diluted whole milk. Whey is often helpful. In Germany buttermilk has been widely used in convalescence from intestinal disturbances. The various proprietary foods, or condensed milk mixed with water, although not to be given over long periods, may be found serviceable in the gradual return of the child to a normal diet.

In children from three to seven years of age these acute derangements are rarely serious, and usually respond promptly after purgation and restricted diet, consisting largely of boiled milk.

It must be borne in mind that injudicious treatment, either in diet or medication, may interrupt what otherwise would be a prompt recovery and bring on the most serious intestinal lesions. The chronic cases, both in infants and older children, especially those with ileo-colitis and ulceration, present unusual difficulties. Each case must be studied by itself. Food which is digested in the upper portion of the intestinal tract is preferable. Milk, properly modified with cereal water or predigested, if intelligently pre-

scribed, offers the best chance of success. The so-called percentage system of milk modification, which enables the physician to alter at will the proportion of fat or carbohydrate present in the milk mixture, is of great service in feeding these long-standing cases.

Care must be taken not to over-feed, although occasionally, when there is persistent anorexia, gavage may be necessary. This is best accomplished through a nasal tube. Some infants will retain food given through a catheter when they will vomit the same mixture taken from a bottle. Beef juice or one of the beef-peptone preparations is frequently useful. They should always be given with considerable fluid. In a large majority of instances ulceration is confined to the large intestine, and can be reached by local treatment. Irrigations which flush the injured surface are of service. They should be discontinued if much exhaustion follows, but this is rare.

No very definite results have followed the various astringent preparations recommended. Probably warm salt or weak soda solutions are as useful. Silver nitrate is stimulating and healing where the ulcerations are in the rectum. In great local irritation and tenesmus, enemata (2 ounces, 60 c. c.) of flaxseed or starch, with 2 to 5 drops (0.12 to 0.3 c. c.) of laudanum, are soothing and beneficial.

Treatment of Cholera Infantum.—In cholera infantum serious symptoms may occur with great rapidity, and here the incessant vomiting and frequent purging render the administration of remedies extremely difficult. Irrigation of the stomach and large bowel is of great service, and when the fever is high ice-water injections may be used, or a graduated bath. As in the acute choleraic diarrhœa of adults, morphia hypodermically is the remedy which gives greatest relief, and in the conditions of extreme vomiting and purging, with restlessness and collapse symptoms, this drug alone commands the situation. A child of one year may be given from 1/100 to 1/80 of a grain (0.00065 to 0.0008 gm.) to be repeated in an hour, and again if not better.

In all cases of diarrhœa convalescence requires very careful management. An infant which has suffered from a severe attack should be especially watched throughout the remainder of the hot weather. During this time it is rarely safe to return to a full diet.

III. APPENDICITIS

Inflammation of the vermiform appendix is the most important of acute intestinal disorders. Formerly the "iliac phlegmon" was thought to be due to disease of the cæcum—typhlitis—or of the peritoneum covering it—perityphlitis; but we now know that with rare exceptions the cæcum itself is not affected, and even the condition formerly described as stercoral typhlitis is in reality appendicitis. The contribution of Fitz in 1886 served to put the whole question on a rational basis. For historical and special details the reader is referred to the monograph of Kelly and Hurdon.

Etiology.—The exciting causes of appendicitis are not always evident. An infection is the essential factor. The lumen of the appendix forms a sort of test-tube, in which the fæces lodge and are with difficulty discharged,

so that the mucosa is liable to injury from retention of the secretions or from the presence of inspissated faeces or occasionally foreign bodies. In some instances the appendicitis is a local expression of a general infection. The causes of the undoubted increase of the disease are not known; some have attributed it to the prevalence of influenza. By others the poison of rheumatic fever is believed to be a cause, and just as it may excite tonsillitis, so it may cause inflammation of the lymphatic tissues of the appendix. It is remarkable, too, that there may be two or three cases of appendicitis at the same time in one family. The acute catarrhal form may be associated with pneumonia or typhoid fever or any of the acute infections. Direct injury, as in straining and heavy lifting, is an occasional exciting cause.

The BACTERIOLOGY of the disease is most varied. The *Bacillus coli* is present in a large number of cases, and the pyogenic organisms, particularly the *Streptococcus pyogenes*. The disease may be produced experimentally in rabbits by the intravenous injection of pneumococci and other organisms; Poynton and Paine have caused it with the organism isolated from rheumatic cases.

AGE.—Appendicitis is a disease of young persons, 50 per cent. of the cases occurring before the twentieth year. It has been met with as early as the seventh week, but it is rarely seen prior to the fifth year. Of 1,223 cases at the Johns Hopkins Hospital only 9 cases were under 5 years, 59 in children under 10, 140 between 11 and 15, 199 between 16 and 20, and 255 between 21 and 25 (Churchman).

SEX.—It is about equally common in males and in females.

OCCUPATION.—Persons whose work necessitates the lifting of heavy weights seem more prone to the disease. Trauma plays a very definite rôle, and in a number of cases the symptoms have followed very closely a fall or a blow.

Indiscretions in diet are very prone to bring on an attack, particularly in the recurring form of the disease, in which pain in the appendix region not infrequently follows the eating of indigestible articles of food.

Varieties.—McCarty from a study of 5,000 appendices removed at the Mayo clinic makes the following classification:

(*a*) APPENDICITIS CATARRHALIS ACUTA, a condition in which the mucosa is infiltrated with leucocytes and congested with inflammatory reaction in the lymph follicles and lymphatic tissues of the submucosa.

(*b*) APPENDICITIS CATARRHALIS CHRONICA, following repeated mild or severe acute catarrh, marked by increase of scar tissue, and distortion of the normal regularity of the structure. Blood pigment is often present.

(*c*) APPENDICITIS PURULENTA NECROTICA, an advanced stage of the acute catarrhal condition, plus the formation of intramural abscesses, necrosis, and perforation.

(*d*) PERI-APPENDICITIS ACUTA, an extension to the peritoneum of the conditions just described.

(*e*) OBLITERATION, a condition of the lumen, the result of destruction of the mucosa and the formation of scar tissue, occurring in about 24 per cent. of all cases, and an inflammatory, not an involutionary, process.

There are cases, too, in which the appendix becomes sphacelated *en masse*, and may slough off.

Fæcal Concretions.—The lumen of the appendix may contain a mould of fæces, which can readily be squeezed out. Even while soft the contents of the tube may be moulded in two or three sections with rounded ends. Concretions —enteroliths, coproliths—are also common. Of 700 cases of foreign bodies there were 15 per cent. of fæcal concretions (J. F. Mitchell). The enteroliths often resemble date stones in shape. The importance of these concretions is shown by the great frequency with which they are found in all acute inflammations of the appendix.

Foreign Bodies.—Of 1,400 cases of appendicitis collected by J. F. Mitchell these were present in 7 per cent.; in 28 cases pins were found. It is well to bear in mind that some of the concretions bear a very striking resemblance to cherry and date stones.

Symptoms.—In a large proportion of all cases of acute appendicitis the following symptoms are present: (*a*) Sudden pain in the abdomen, usually referred to the right iliac fossa; (*b*) fever, often of moderate grade; (*c*) gastro-intestinal disturbance—nausea, vomiting, and frequently constipation; (*d*) tenderness or pain on pressure in the appendix region.

Pain.—A sudden, violent pain in the abdomen is, according to Fitz, the most constant, first, decided symptom of perforating inflammation of the appendix, and occurred in 84 per cent. of the cases analyzed by him. In fully half of the cases it is localized in the right iliac fossa, but it may be central, diffuse, but usually in the right half of the abdomen. Even in the cases in which the pain is at first not in the appendix region it is usually felt here within thirty-six or forty-eight hours. It may extend toward the perineum or testicle. It is sometimes very sharp and colic-like, and cases have been mistaken for nephritic or for biliary colic. Some patients speak of it as a sharp, intense pain—serous-membrane pain: others as a dull ache—connective-tissue pain. While a very valuable symptom, pain is at the same time one of the most misleading. Some of the forms of recurring pain in the appendix region Talamon has called appendicular colic. The condition is believed to be due to partial occlusion of the lumen, leading to violent and irregular peristaltic action of the ~~circular and longitudinal~~ muscles in the expulsion of the mucus.

Fever.—Fever is always present in the early stage, even in the mildest forms, and is a most important feature. J. B. Murphy states that he would not operate on a case in which he was confident that no fever had been present in the first thirty-six hours of the disease. An initial chill is very rare. The fever may be moderate, from 100° to 102°; sometimes in children at the very outset the thermometer may register above 103.5°. The thermometer is one of the most trustworthy guides in the diagnosis of acute appendicitis. Appendicular colic of great severity may occur without fever. When a localized abscess has formed, and in some very virulent cases of general peritonitis, the temperature may be normal, but at this stage there are other symptoms which indicate the gravity of the situation. The pulse is quickened in proportion to the fever.

Gastro-intestinal Disturbance.—The tongue is usually furred and moist, seldom dry. Nausea and vomiting are symptoms which may be absent, but ~~which~~ are commonly present in ~~the~~ acute perforative cases. The vomiting rarely persists beyond the second day in favorable cases. Constipation

is the rule, but the attack may set in with diarrhœa, particularly in children.

Local Signs.—Inspection of the abdomen is at first negative; there is no distention, and the iliac fossæ look alike. On palpation there are usually from the outset two important signs—namely, great tension of the right rectus muscle, and tenderness or actual pain on deep pressure. The muscular rigidity may be so great that a satisfactory examination can not be made without an anæsthetic. McBurney has called attention to the value of a localized point of tenderness on deep pressure, which is situated at the intersection of a line drawn from the navel to the anterior-superior spine of the ilium, with a second, vertically placed, corresponding to the outer edge of the right rectus muscle. Firm, deep, continuous pressure with one finger at this spot causes pain, often of the most exquisite character. In addition to the tenderness, rigidity, and actual pain on deep pressure, there is to be felt, in a majority of the cases, an induration or swelling. In some cases this is a boggy, ill-defined mass in the situation of the cæcum; more commonly the swelling is circumscribed and definite, situated in the iliac fossa, two or three fingers' breadth above Poupart's ligament. Some have been able to feel and roll beneath the fingers the thickened appendix. The later the case comes under observation the greater the probability of the existence of a well-marked tumor mass. It is not to be forgotten that there may be neither tumor mass nor induration to be felt in some of the most intensely virulent cases of perforative appendicitis. The pain may be mistaken for that of hip joint disease.

In addition may be mentioned great irritability of the bladder, which may be a very early symptom. The urine is scanty and often contains albumin and indican. The attitude is somewhat suggestive, the decubitus is dorsal, and the right leg is semi-flexed. Examination *per rectum* in the early stages rarely gives any information of value. The symptoms may be entirely pelvic when the appendix dips over the brim, and the inflamed area is in direct contact with the uterine adnexa.

Leucocytosis.—The blood picture is of value equal to the pulse and temperature. As a rule, in acute attacks there is a leucocytosis of 12,000 to 15,000, chiefly of the polynuclears. In mild catarrhal cases there may be no increase. Usually the degree is an expression of the peritoneal irritation. A low leucocytosis or a leucopenia with increase in the mononuclear neutrophiles, what is called Arnette's blood picture, is an indication of a virulent infection.

Albuminuria is common. Sometimes there is an acute nephritis, and Dieulafoy has described an acute toxic form. He thinks that the kidneys are not infrequently damaged in the disease.

There are three possibilities in any case: (1) Gradual recovery, (2) the formation of a local abscess, and (3) general peritonitis.

Recovery is the rule in the mild catarrhal cases. The pain lessens at the end of the second or third day, the temperature falls, the tongue becomes cleaner, the vomiting ceases, the local tenderness is less marked, and the bowels are moved. By the end of a week the acute symptoms have subsided. So liable is the attack to recur that relapsing appendicitis is spoken of.

Local Abscess Formation.—As a result of ulceration and perforation,

sometimes following the necrosis, by the end of the fourth or fifth day there is an extensive area of induration in the right iliac fossa, with great tenderness, and operations have shown that even at this very early date an abscess cavity may have formed. Though as a rule the fever becomes aggravated with the onset of suppuration, this is not always the case. The two most important elements in the diagnosis of abscess formation are the gradual increase of the local tumor and the aggravation of the general symptoms. Nowadays, when operation is so frequent, we have opportunities of seeing the abscess in various stages of development. Quite early the pus may lie between the cæcum and the coils of the ileum, with the general peritoneum shut off by fibrin, or there is a sero-fibrinous exudate with a slight amount of pus between the lower coils of the ileum. The abscess cavity may be small and lie on the psoas muscle, or at the edge of the promontory of the sacrum, and never reach a palpable size. The sac, when larger, may be roofed in by the small bowel and present irregular processes and pockets leading in different directions. In larger collections in the iliac fossa the roof is generally formed by the abdominal wall. Some of the most important of the localized abscesses are those which are situated entirely within the pelvis. The various directions and positions into which the abscess may pass or perforate have already been referred to under morbid anatomy, but it may be here mentioned again that, left alone, it may discharge externally, burrow in various directions, or be emptied through the rectum, vagina, or bladder. Death may be caused by septicæmia, by perforation into an artery or vein, or by pylephlebitis.

General Peritonitis.—This may be caused by direct perforation of the appendix and general infection of the peritoneum before any delimiting inflammation is excited. In a second group of cases there has been an attempt at localizing the infective process, but it fails, and the general peritoneum becomes involved. In a third group of cases a localized focus of suppuration exists about an inflamed appendix, and from this perforation takes place.

Death in appendicitis is due usually to general peritonitis.

The gravity of appendix disease lies in the fact that from the very onset the peritoneum may be infected; the initial symptoms of pain, with nausea and vomiting, fever, and local tenderness, present in all cases, may indicate a wide-spread infection of this membrane. The onset is usually sudden, the pain diffuse, not always localized in the right iliac fossa, but it is not so much the character as the greater intensity of the symptoms from the outset that makes one suspicious of a general peritonitis. Abdominal distention, diffuse tenderness, and absence of abdominal movements are the most trustworthy local signs, but they are not really so trustworthy as the general symptoms. The initial nausea and vomiting persist, the pulse becomes more rapid, the tongue is dry, the urine scanty. In very acute cases, by the end of twenty-four hours the abdomen may be distended. By the third and fourth days the classical picture of a general peritonitis is well established—a distended and motionless abdomen, a rapid pulse, a dry tongue, dorsal decubitus with the knees drawn up, and an anxious, pinched, Hippocratic facies. The picture may be that of septicopyæmia or sapræmia; high fever, chills, sweats, without local reaction. These are generally acute, gangrenous cases with anomalous position of the appendix, behind the colon, or deep in the pelvis. Even when looked for carefully there may be no local indications.

Sometimes there have been gastro-intestinal symptoms for a few days before, to which no attention has been paid by the family. In one case, seen by the family physician at 2 p. m. for the first time, by me at 4.30 p. m., at 7 p. m. by a surgeon who refused to operate, death occurred within 12 hours after the physician was first called.

Remote Effects.—The remote effects of perforative appendicitis are interesting. Hæmorrhage may occur. In one of my cases the appendix was adherent to the promontory of the sacrum, and the abscess cavity had perforated in two places into the ileum. Death resulted from profuse hæmorrhage. Cases are on record in which the internal iliac artery or the deep circumflex iliac artery has been opened. Suppurative pylephlebitis may result from inflammation of the mesenteric veins near the perforated appendix. The appendix may perforate in a hernial sac. Many instances of this have been recorded.

After operation, thrombosis of the iliac or femoral veins is not uncommon, and sudden death from pulmonary embolism has followed. The leg may be permanently enlarged. Hernia may occur in the wound. Strangulation of the bowel is an occasional sequence. Recurrence of the symptoms after operation has been noted, due in some cases to incomplete removal.

Diagnosis.—Appendicitis is by far the most common inflammatory condition, not only in the cæcal region, but in the abdomen generally in persons under thirty. The surgeons have taught us that, almost without exception, sudden pain in the right iliac fossa, with fever and localized tenderness, with or without tumor, means appendix disease. There are certain diseases of the abdominal organs characterized by pain which are apt to be confounded with appendicitis. Biliary colic, kidney colic, and the colicky pains at the menstrual period in women have in some cases to be most carefully considered.

Diseases of the tubes and pelvic peritonitis may simulate appendicitis very closely, but the history and the local examination under ether should in most cases enable the practitioner to reach a diagnosis. I have seen several cases supposed to be recurring appendicitis which proved to be tubo-ovarian disease.

The Dietl's crises in floating kidney have been mistaken for appendicitis.

Acute hæmorrhagic pancreatitis may also produce symptoms very like those of appendicitis with general peritonitis. The relation of typhoid fever and appendicitis is interesting. The gastro-intestinal symptoms, particularly the pain and the fever, may at the onset suggest appendicitis. Operations have been comparatively frequent. In the second and third weeks of typhoid fever perforation of the appendix may occur, and occasionally late in the convalescence perforation of an unhealed ulcer of the appendix.

In a great many patients with chronic appendicitis stomach symptoms predominate, and an appendicular dyspepsia has been recognized particularly by the French writers and by surgeons. Many of the patients are neurotic. The dyspeptic symptoms are irregular, and food rarely gives relief, as in ulcer. Pain is the prevailing symptom, often caused by food, and more abdominal than epigastric, without radiation, and there are frequently pain and tenderness at McBurney's point. Vomiting is rare, but there is usually much flatulency. Without being seriously ill, the patient's condition is constantly

pain produced by pulling on rgt. spermatic cord.
frequent micturition - pulse 72 w. chirdus.
withdrew finger into rgt. inguinal canal. - spasm.
through scrotal pain.
cremasteric reflex less urgent on rgt. side of
scrotal abdn.

below par, and he may go the rounds of physicians for years. In an analysis of 100 cases of this type at the Mayo clinic by Graham and Guthrie, reported on a year after operation, 77 per cent. were cured by the removal of the appendix. As a majority of these patients are neurotic, it is not easy to say how far the good results have been due directly to the removal of the appendix, the pathological condition of which, as reported upon by Graham and Guthrie, did not seem to differ much from that which is met with, according to Aschoff, in a majority of individuals in the fourth decade. I can testify that in a certain number of these patients the relief after removal of the appendix has not been permanent.

There is a well-marked appendicular hypochondriasis. Through the pernicious influence of the daily press, appendicitis has become a sort of fad, and the physician has often to deal with patients who have almost a fixed idea that they have the disease. The worst cases of this class which I have seen have been in members of our profession, and I know of at least one instance in which a perfectly normal appendix was removed. The question really has its ludicrous side. A well-known physician in a Western city having one night a bellyache, and feeling convinced that his appendix had perforated, summoned a surgeon, who quickly removed the supposed offender!

Hysteria may of course simulate appendicitis very closely, and it may require a very keen judgment to make a diagnosis. Mucous colitis with enteralgia in nervous women is sometimes mistaken for appendicitis.

Perinephritic and pericæcal abscess from perforation of ulcer, either simple or cancerous, and circumscribed peritonitis in this region from other causes, can rarely be differentiated until an exploratory incision is made.

Chronic obliterative appendicitis can not always be differentiated from the perforative form, and in intensity of pain, severity of symptoms, and, in rare instances, even in the production of peritonitis, the two may be identical.

Briefly stated, localized pain in the right iliac fossa, with or without induration or tumor, the existence of McBurney's tender point, fever, furred tongue, vomiting, with constipation or diarrhœa, indicate appendicitis. The occurrence of general peritonitis is suggested by increase and diffusion of the abdominal pain, tympanites (as a rule), marked aggravation of the constitutional symptoms, particularly elevation of fever and increased rapidity of the pulse. Obliteration of hepatic dulness is rarely present, as the peritoneum in these cases does not often contain gas.

Appendicitis and Pregnancy.—The association is not uncommon. Of 103 perforative or gangrenous cases 89 were operated upon, with 36 deaths. Of 14 cases not operated upon all died. Of the 103 cases 80 aborted before or after operation. Of 104 non-perforative cases 50 were operated upon with 1 death; of the remaining 54, 4 died; 13 of these non-perforative cases aborted (Babler). Mild cases recover; in the severer forms it is safer to operate at once.

Prognosis.—*There would be no percentage of deaths from appendicitis if every case commencing with acute pain and developing tenderness and rigidity of the abdomen and quickening of the pulse were operated upon within twelve hours* (Rutherford Morison).

Treatment.—Gradually the profession has learned to recognize that ap-

pendicitis is a surgical disease. In hospital practice the cases should be admitted directly to the surgical wards. Many lives are lost by temporizing. The general practitioner does well to remember—whether his leanings be toward the conservative or the radical methods of treatment—that the surgeon is often called too late, never too early.

There is no medicinal treatment of appendicitis. There are remedies which will allay the pain, but there are none capable in any way of controlling the course of the disease. Rest in bed, a light diet, measures directly to allay the vomiting—upon these all are agreed. The practice of giving opium in some form in appendicitis and peritonitis is decreasing, but is still too common. Surgeons almost unanimously condemn the practice, as obscuring the clinical picture and tending to give a false sense of security; and since they control the situation, we should not give opium, and trust to the persistent use of ice locally to relieve the pain. General opinion among the best surgeons is, I believe, opposed to the use of saline purges.

Operation is indicated in all cases of acute inflammatory trouble in the cæcal region, whether tumor is present or not, when the general symptoms are severe, and *when at the end of twelve hours, or even earlier, the features of the case point to a progressive lesion.* The mortality from early operation under these circumstances is very slight.

In recurring appendicitis, when the attacks are of such severity and frequency as seriously to interrupt the patient's occupation, the mortality in the hands of capable operators is very small.

IV. INTESTINAL OBSTRUCTION

Intestinal obstruction may be caused by strangulation, intussusception, twists and knots, strictures and tumors, by abnormal contents, and by paralysis of the muscular coat of the bowel.

Etiology and Pathology.—(*a*) STRANGULATION.—This is the most frequent cause of acute obstruction, and occurred in 34 per cent. of the 295 cases analyzed by Fitz, and in 35 per cent. of the 1,134 cases of Leichtenstern. Of the 101 cases of strangulation in Fitz's table, which has the special value of having been carefully selected from the literature since 1880, the following were the causes: Adhesions, 63; vitelline remains, 21; adherent appendix, 6; mesenteric and omental slits, 6; peritoneal pouches and openings, 3; adherent tube, 1; pedunculer tumor, 1. The bands and adhesions result, in a majority of cases, from former peritonitis. A number of instances have been reported following operations upon the pelvic organs in women. The strangulation may be recent and due to adhesion of the bowel to the abdominal wound or a coil may be caught between the pedicle of a tumor and the pelvic wall. Such cases are only too common. Late occlusion after recovery from the operation is due to bands and adhesions.

The vitelline remains are represented by Meckel's diverticulum, which forms a finger-like projection from the ileum, usually within eighteen inches of the ileo-cæcal valve. It is a remnant of the omphalo-mesenteric duct, through which, in the early embryo, the intestine communicated with the yolk-sac. The end, though commonly free, may be attached to the abdominal

no [illegible]. no purgation, (enemas if necessary)

Whipple. J.A.M.A 1915 65, 476

Mixture + proteose [illegible]

wall near the navel, or to the mesentery, and a ring is thus formed through which the gut may pass.

Seventy per cent. of the cases of obstruction from strangulation occur in males; 40 per cent. of all the cases occur between the ages of fifteen and thirty years. In 90 per cent. of the cases of obstruction from these causes the site of the trouble is in the small bowel; the position of the strangulated portion was in the right iliac fossa in 67 per cent. of the cases, and in the lower abdomen in 83 per cent.

(*b*) Intussusception.—In this condition one portion of the intestine slips into an adjacent portion, forming an invagination or intussusception. The two portions make a cylindrical tumor, which varies in length from a half inch to a foot or more. The condition is always a descending intussusception, and, as the process proceeds, the middle and inner layers increase at the expense of the outer layer. An intussusception consists of three layers of bowel: the outermost, known as the intussuscipiens, or receiving layer; a middle or returning layer; and the innermost or entering layer. The student can obtain a clear idea of the arrangement by making the end of a glove-finger pass into the lower portion. The actual condition can be very clearly studied in the post mortem invaginations which are so common in the small bowel of children. In the statistics of Fitz, 93 of 295 cases of acute intestinal obstruction were due to this cause. Of these, 52 were in males and 27 in females. The cases are most common in early life, 34 per cent. under one year and 56 per cent. under the tenth year. Of 103 cases in children, nearly 50 per cent. occurred in the fourth, fifth, and sixth months (Wiggin). No definite causes could be assigned in 42 of the cases; in the others diarrhœa or habitual constipation had existed.

The site of the invagination varies. We may recognize (1) an *ileo-cæcal,* when the ileo-cæcal valve descends into the colon. There are cases in which this is so extensive that the valve has been felt *per rectum.* This form occurred in 75 per cent. of the cases; in 89 per cent. of Wiggin's collected cases. In the *ileo-colic* the lower part of the ileum passes through the ileo-cæcal valve. (2) The *ileal,* in which the ileum is alone involved. (3) The *colic,* in which it is confined to the large intestine. (4) *Colico-rectal,* in which the colon and rectum are involved. (5) Intussusception of the appendix is rare, but there are about 30 cases on record, most of them in children.

Irregular peristalsis is the essential cause of intussusception. Nothnagel found in the localized peristalsis caused by the faradic current that it was not the descent of one portion into the other, but the drawing up of the receiving layer by contraction of the longitudinal coat. Invagination may follow any limited, sudden, and severe peristalsis.

In the post mortem examination, in a case of death from intussusception, the condition is very characteristic. Peritonitis may be present or an acute injection of the serous membrane. When death occurs early, as it may do from shock, there is little to be seen. The portion of bowel affected is large and thick, and forms an elongated tumor with a curved outline. The parts are swollen and congested, owing to the constriction of the mesentery between the layers. The entire mass may be of a deep livid-red color. In very recent processes there is only congestion, and perhaps a thin layer of lymph, and the intussusception can be reduced, but when it has lasted for a

few days, lymph is thrown out, the layers are glued together, and the entering portion of the gut can not be withdrawn.

The anatomical condition accounts for the presence of the tumor, which exists in two-thirds of all cases; and the engorgement, which results from the compression of the mesenteric vessels, explains the frequent occurrence of blood in the discharges, which has so important a diagnostic value. If the patient survives, necrosis and sloughing of the invaginated portion may occur, and, if union has taken place between the inner and outer layers, the calibre of the gut may be restored and a cure in this way effected. Many cases of the kind are on record. In the Museum of ~~the Medical Faculty of the~~ McGill University are 17 inches of small intestine, which were passed by a lad who had symptoms of internal strangulation, and who made a complete recovery.

(*c*) Twists, Knots, and Traction Kinks.—Volvulus or twist occurred in 42 of the 295 cases (Fitz). Sixty-eight per cent. were in males. It is most frequent between the ages of thirty and forty. In the great majority of all cases the twist is axial and associated with an unusually long mesentery. In 50 per cent. of the cases it was in the sigmoid flexure. The next most common situation is about the cæcum, which may be twisted upon its axis or bent upon itself. As a rule, in volvulus the loop of bowel is simply twisted upon its long axis, and the portions at the end of the loop cross each other and so cause the strangulation. It occasionally happens that one portion of the bowel is twisted about another.

Traction kinks occur at three regions—the third portion of the duodenum, the last part of the ileum, and the sigmoid flexure. What is known as gastro-mesenteric ileus is caused by compression of the lower portion of the duodenum by the root of the mesentery with its contained blood-vessels. The condition has been described under acute dilatation of the stomach.

The *ileum kink* occurs within a few inches of the cæcum. This portion has a short tight mesentery and a large loose cæcum sags over the brim of the pelvis and may cause a definite kink of the ileum with constipation, pain in the right iliac fossa, and symptoms which simulate appendicitis.

Traction of a very full sigmoid flexure may, without any special twist, compress and obstruct a neighboring coil of the colon.

(*d*) Strictures and Tumors.—These are very much less important causes of acute obstruction, as may be judged by the fact that there are only 15 instances out of the 295 cases, in 14 of which the obstruction occurred in the large intestine (Fitz). On the other hand, they are common causes of chronic obstruction.

Lipoma may occur, growing from the submucosa, and cause intussusception. In a number of cases the tumor has been passed *per rectum*. S. B. Ward ~~has~~ collected 9 cases.

The obstruction may result from: (1) *Congenital stricture.* These are exceedingly rare. Much more commonly the condition is that of complete occlusion, either forming the imperforate anus or the congenital defect by which the duodenum is not united to the pylorus. (2) *Simple cicatricial stenosis,* which results from ulceration, tuberculous or syphilitic, more rarely from dysentery, and most rarely of all from typhoid ulceration. (3) *New growths.* The malignant strictures are due chiefly to cylindrical epithelioma,

which forms an annular tumor, most commonly met with in the large bowel, about the sigmoid flexure, or the descending colon. Of benign growths, papillomata, adenomata, lipomata, and fibromata occasionally induce obstruction. (4) *Compression and traction.* Tumors of neighboring organs, particularly of the pelvic viscera, may cause obstruction by adhesion and traction. In the healing of tuberculous peritonitis the contraction of the thick exudate may cause compression and narrowing of the coils.

(*e*) Abnormal Contents.—Foreign bodies, such as fruit stones, coins, pins, needles, or false teeth, are occasionally swallowed accidentally, or by lunatics on purpose. Round worms may become rolled into a tangled mass and cause obstruction. In reality, however, the majority of foreign bodies, such as coins, buttons, and pins, swallowed by children, cause no inconvenience whatever, but in a day or two are found in the stools. Occasionally such a foreign body as a pin will pass through the œsophagus and will be found lodged in some adjacent organ, as in the heart (Peabody), or a barley ear may reach the liver (Dock).

Medicines, such as magnesia or bismuth, have been known to accumulate in the bowels and produce obstruction, but in the great majority of the cases the condition is caused by fæces, gall-stones, or enteroliths. Of 44 cases, in 23 the obstruction was by gall-stones, in 19 by fæces, and in 2 by enteroliths. Obstruction by fæces may happen at any period of life. As mentioned when speaking of dilatation of the colon, it may occur in young children and persist for weeks. In fæcal accumulation the large bowel may reach an enormous size and the contents become very hard. The retained masses may be channeled, and small quantities of fæcal matter are passed until a mass too large enters the lumen and causes obstruction. There may be very few symptoms, as the condition may be borne for weeks or even for months.

Obstruction by gall-stones is not very infrequent, as may be gathered from the fact that 23 cases were reported in the literature in eight years. Eighteen of these were in women and 5 in men. In six-sevenths of the cases it occurred about the fiftieth year. The obstruction is usually in the ileo-cæcal region, but it may be in the duodenum. These large solitary gall-stones ulcerate through the gall-bladder, usually into the small intestine, occasionally into the colon. In the latter case they rarely cause obstruction. Courvoisier has collected 131 cases in the literature.

Enteroliths may be formed of masses of hair, more commonly of the phosphates of lime and magnesia, with a nucleus formed of a foreign body or of hardened fæces. Nearly every museum possesses specimens of this kind. They are not so common in men as in ruminants, and, as indicated in Fitz's statistics, are very rare causes of obstruction.

(*f*) Paralytic Ileus.—Without any obstruction in the lumen, in a localized area or in a wide section of the bowel, the muscular walls may be so paralyzed that no movement of the contents occurs, causing a condition which virtually amounts to obstruction. The best illustrations of local paralytic ileus are seen in the embolic and thrombotic processes in the mesenteric arteries, when the corresponding portions of the intestinal wall are in a state of infarct. This is the condition which occurs in the verminous aneurism in a horse, and is associated with the common intestinal colic. It is more common in the small than in the large bowel, but I saw an in-

stance of paralytic ileus due to localized involvement of about eight inches of the wall of the transverse colon without, so far as one could discover, any affection of the blood-vessels; and the symptoms were those of acute obstruction.

Following operations, particularly on the abdomen, after injuries, following paracentesis in ascites, in pneumonia, pleurisy, and occasionally in heart disease, a paralytic state of the bowel may occur, with cessation of peristalsis, distention of the abdomen, vomiting, and other signs of obstruction. There are remarkable cases of hysteria with symptoms of chronic obstruction of the bowels and fæcal vomiting—the so-called ileus hystericus.

Symptoms.—(*a*) Acute Obstruction.—Constipation, pain in the abdomen, and vomiting are the three important symptoms. Pain sets in early and may come on abruptly while the patient is walking, or, more commonly, during the performance of some action. It is at first colicky in character, but subsequently it becomes continuous and very intense. Vomiting follows quickly and is a constant and most distressing symptom. At first the contents of the stomach are voided, and then greenish, bile-stained material, and soon, in cases of acute and permanent obstruction, the material vomited is a brownish-black liquid, with a distinctly fæcal odor. This sequence of gastric, bilious, and, finally, stercoraceous vomiting is perhaps the most important diagnostic feature of acute obstruction. The constipation may be absolute, without the discharge of either fæces or gas. Very often the contents of the bowel below the stricture are discharged. Distention of the abdomen usually occurs, and, when the large bowel is involved, it is extreme. On the other hand, if the obstruction is high up in the small intestine, there may be very slight tympany. At first the abdomen is not painful, but subsequently it may become acutely tender.

The constitutional symptoms from the outset are severe. The face is pallid and anxious, and finally collapse symptoms supervene. The eyes become sunken, the features pinched, and the skin is covered with a cold, clammy sweat. The pulse becomes rapid and feeble. There may be no fever; the axillary temperature is often subnormal. The tongue is dry and parched and the thirst is incessant. The urine is high-colored, scanty, and there may be suppression, particularly when the obstruction is high up in the bowel. This is probably due to the constant vomiting and the small amount of liquid which is absorbed. The case terminates, as a rule, in from three to six days. In some instances the patient dies from shock or sinks into coma. A leucocytosis of 75,000 or 80,000 per c. mm. may be present.

(*b*) Symptoms of Chronic Obstruction.—When due to fæcal impaction, there is a history of long-standing constipation. There may have been discharge of mucus, or, in some instances, the fæcal masses have been channeled, and so have allowed the contents of the upper portion of the bowel to pass through. In elderly persons this is not infrequent; but examination, either *per rectum* or externally, in the course of the colon, will reveal the presence of hard scybalous masses. There may be retention of fæces for weeks without exciting serious symptoms. In other instances there are vomiting, pain in the abdomen, gradual distention, and finally the ejecta become fæcal. The hardened masses may excite an intense colitis or even peritonitis.

In stricture, whether cicatricial or cancerous, the symptoms of obstruc-

absence de sommet

tion are very diverse. Constipation gradually comes on, is extremely variable, and it may be months or even years before there is complete obstruction. There are transient attacks, in which from some cause the fæces accumulate above the stricture, the intestine becomes greatly distended, and in the swollen abdomen the coils can be seen in active peristalsis. In such attacks there may be vomiting, but it is very rarely of a fæcal character. In the majority of these cases the general health is seriously impaired; the patient gradually becomes anæmic and emaciated, and, finally, in an attack in which the obstruction is complete, death occurs with all the features of acute occlusion, or the case may be prolonged for ten or twelve days.

Diagnosis.—(*a*) THE SITUATION OF THE OBSTRUCTION.—Hernia must be excluded, which is by no means always easy, as fatal obstruction may occur from the involvement of a very limited portion of the gut in the external ring or in the obturator foramen. A thorough rectal and, in women, a vaginal examination should be made, which will give important information as to the condition of the pelvic and rectal contents, particularly in cases of intussusception, in which the descending bowel can sometimes be felt. In cases of obstruction high up the empty coils sink into the pelvis and can there be detected. Rectal exploration with the entire hand is of doubtful value. In the inspection of the abdomen there are important indications, as the special prominence in certain regions, the occurrence of well-defined masses, and the presence of hypertrophied coils in active peristalsis. John Wyllie has called attention to the great value in diagnosis of the "patterns of abdominal tumidity." In obstruction of the lower end of the large intestine not only may the horseshoe of the colon stand out plainly, when the bowel is in rigid spasm, but even the pouches of the gut may be seen. When the cæcum or lower end of the ileum is obstructed the tumidity is in the lower central region, and during spasm the coils of the small bowel may stand out prominently, one above the other, either obliquely or transversely placed—the so-called "ladder pattern." In obstruction of the duodenum or jejunum there may only be slight distention of the upper part of the abdomen, associated usually with rapid collapse and anuria.

In the ileum and cæcum the distention is more in the central portion of the abdomen; the vomiting is distinctly fæcal and occurs early. In obstruction of the colon tympanites is much more extensive and general. Tenesmus is more common, with the passage of mucus and blood. The course is not so quick, the collapse does not supervene so rapidly, and the urinary secretion is not so much reduced.

In obstruction from stricture or tumor the situation can in some cases be accurately localized, but in others it is very uncertain. Digital examination of the rectum should first be made. The rectal tube may then be passed, but it is impossible to get beyond the sigmoid flexure. In the use of the rigid tube there is danger of perforation of the bowel in the neighborhood of a stricture. The quantity of fluid which can be passed into the large intestine should be estimated. The capacity of the large bowel is about six quarts. Wiggin advises about a pint and a half from a height of three feet for an infant. To thoroughly irrigate the bowel the patient should be chloroformed and should lie on the back or on the side—best on the back, with the hips elevated. Treves suggests that the cæcal region should be auscultated during

the passage of the fluid. For diagnostic purposes the rectum may be inflated, either by the bellows or by the use of bicarbonate of soda and tartaric acid. In certain cases these measures give important indications as to the situation of the obstruction in the large bowel.

(*b*) Nature of the Obstruction.—This is often difficult, not infrequently impossible, to determine. *Strangulation* is not common in very early life. In many instances there have been previous attacks of abdominal pain, or there are etiological factors which give a clew, such as old peritonitis or operation on the pelvic viscera. Neither the onset nor the character of the pain gives us any information. In rare instances nausea and vomiting may be absent. The vomiting usually becomes fæcal from the third to the fifth day. A tumor is not common in strangulation, and was present in only one-fifth of the cases. Fever is not of diagnostic value.

Intussusception is an affection of childhood, and is of all forms of internal obstruction the one most readily diagnosed. The presence of tumor, bloody stools, and tenesmus are the important factors. The tumor is usually sausage-shaped and felt in the region of the transverse colon. It existed in 66 of 93 cases. It became evident the first day in more than one-third of the cases, on the second day in more than one-fourth, and on the third day in more than one-fifth. Blood in the stools occurs in at least three-fifths of the cases, either spontaneously or following the use of an enema. The blood may be mixed with mucus. Tenesmus is present in one-third of the cases. Fæcal vomiting is not very common and was present in only 12 of the 93 instances. Abdominal tympany is a symptom of slight importance, occurring in only one-third of the cases.

Volvulus can rarely be diagnosed. The frequency with which it involves the sigmoid flexure is to be borne in mind. The passage of a flexible tube or injecting fluids might in these cases give valuable indications.

In fæcal obstruction the condition is usually clear, as the fæces can be felt *per rectum* and also in the distended colon. Fæcal vomiting, tympany, abdominal pain, nausea, and vomiting are late and are not so constant. In obstruction by gall-stone a few of the cases gave a previous history of gall-stone colic. Jaundice was present in only 2 of the 23 cases. Pain and vomiting, as a rule, occur early and are severe, and fæcal vomiting is present in two-thirds of the cases. A tumor is rarely evident.

(*c*) Diagnosis from Other Conditions.—Acute enteritis with great relaxation of the intestinal coils, vomiting, and pain may be mistaken for obstruction. Of late years many instances have been reported in which peritonitis following disease of the appendix has been mistaken for acute obstruction. The intense vomiting, the general tympany and abdominal tenderness, and, in some instances, the suddenness of the onset are very deceptive. In appendix disease the temperature is more frequently elevated, the vomiting is never fæcal, and in many cases there is a history of previous attacks in the cæcal region. Acute hæmorrhagic pancreatitis may produce symptoms which simulate closely intestinal obstruction.

Treatment.—Purgatives should not be given. For the pain hypodermic injections of morphia are indicated. To allay the distressing vomiting, the stomach should be washed out. Not only is this directly beneficial, but Kussmaul claims that the abdominal distention is relieved, the pressure in

Snow. J.A.M.A. 1915. 65. 1524. Oct 30.

pain - empty. shock. then a deceptive lull.

vomiting. may come & go

Tumor - sinus tibiæ = may vary in position & go under liver or into loin

by rectum - on left = may be return but this is easily displaced when

a mass of intestine is not.

X-ray, when bismuth in rectum

Ileo-caecal valve — a neuro-muscular contrivance rather than a valve. In ileus — i.e. in obstruction of spinothoracic centres — this is a distinguishable landmark. Due to loss of sympathetic tone + mechanical interference

Inhibitory centre in the terminal ileum

the bowel above the seat of obstruction is lessened, and the violent peristalsis is diminished. It may be practiced three or four times a day, and in some instances has proved beneficial; in others curative. Thorough irrigation of the large bowel with injections should be practiced, the warm fluid being allowed to flow in from a fountain syringe and the amount carefully estimated.

Inflation may also be tried, by forcing the air into the rectum with the bellows or with a Davidson's syringe. It is a measure not without risk, as instances of rupture of the bowel have been reported. Of 39 cases in children treated by inflation or enemata 16 recovered (Wiggin). In cases of acute obstruction surgical measures should be resorted to early.

For the tympanites turpentine stupes and hot applications may be applied. In cases of chronic obstruction the diet must be carefully regulated, and opium and belladonna are useful for the paroxysmal pains. Enemata should be employed, and, if the obstruction becomes complete, resort must be had to surgical measures.

V. CONSTIPATION

(*Costiveness*)

Definition.—Retention of fæces from any cause.

Constipation in Adults.—The causes are varied and may be classed as general and local.

General Causes.—(*a*) Constitutional peculiarities: Torpidity of the bowels is often a family complaint and is found more often in dark than in fair persons. (*b*) Sedentary habits, particularly in persons who eat too much and neglect the calls of nature. (*c*) Certain diseases, such as anæmia, neurasthenia, and hysteria, chronic affections of the liver, stomach, and intestines, and the acute fevers. Under this heading may appropriately be placed that most injurious of all habits, *drug-taking*. (*d*) Either a coarse diet, which leaves too much residue, or a diet which leaves too little.

Local Causes.—Weakness of the abdominal muscles in obesity or from overdistention in repeated pregnancies. Atony of the large bowel from chronic disease of the mucosa; the presence of tumors, physiological or pathological, pressing upon the bowel; enteritis; foreign bodies, large masses of scybala, and strictures of all kinds. An important local cause is atony of the colon, particularly of the muscles of the sigmoid flexure by which the fæces are propelled into the rectum. An obstinate form is that associated with a contracted state of the bowel, sometimes spoken of as spasmodic constipation. This is met with—first, as a sequence of chronic dysentery or ulcerative colitis; secondly, in protracted cases of hysteria and neurasthenia in women, particularly in association with uterine disease; and, thirdly, in very old persons often without any definite cause. It may be that the sigmoid flexure and lower colon are in a condition of contraction and spasm, while the transverse and ascending parts are in a state of atony and dilatation. The most characteristic sign of this variety is the presence of hard, globular masses, or, more rarely, small and sausage-like fæces.

Radiography has taught us much of the conditions favoring intestinal

stasis. The upward position in man favors visceroptosis, with which we find associated many of the most obstinate cases of constipation. Arbuthnot Lane has emphasized the fact of this dropping or dragging of the intestines, particularly at certain points—e. g., the third part of the duodenum, at the end of which there may be an abrupt kink associated with a considerable dilatation of the duodenum itself. This is of course relieved immediately when the patient lies down. The second is the ileal kink, already spoken of, caused by a dropping of the cæcum, and the lower coil of the ileum itself. The obstruction may result in considerable dilatation of the end of the ileum, with delay in the passage of the fluid fæces. A third point is the fixed splenic flexure of the colon, and the X-ray may show an ascending colon as low as the level of the iliac crest, and the transverse in the pelvis necessarily causing delay in the passage of the fæces past this angle. The sigmoid loop seems specially designed to promote stasis; the rectum may also present an elongated S-shaped loop, and, finally, there is the sharp pelvi-rectal flexure, above which the fæces accumulate.

~~The studies of Hertz, Jordan, and others have shown how accurately~~ The rate of the passage of the fæces through the large bowel ~~may~~ be estimated with the X-rays. After a bismuth meal the cæcum is reached in about four hours, the hepatic flexure two hours later, the splenic flexure three hours after that, and the beginning of the pelvic colon twelve hours after the commencement of the meal. The fæces do not pass beyond the pelvi-rectal flexure until just before defæcation.

Hurst

~~Hertz~~ divides all cases of constipation into two main groups. In one the delay occurs in the passage through the colon, particularly in the distal half; in the other the passage as far as the pelvic colon is normal, but defæcation is not properly performed. Every case of chronic constipation ought to be carefully studied with the X-rays.

Symptoms.—The most persistent constipation for weeks or even months may exist with fair health. Debility, lassitude, and a mental depression are frequent symptoms in constipation, particularly in persons of a nervous temperament. Headache, loss of appetite, a furred tongue, and foul breath may also occur. In girls the skin is "muddy," acne is common, chlorosis may follow, and there is a flabby state of the system generally. ~~Lane claims that~~ chronic mastitis, chronic pancreatitis and gall-stones may follow ~~intestinal stasis~~.

When persistent, the accumulation of fæces leads to unpleasant, sometimes serious, local symptoms, such as piles, ulceration of the colon, distention of the sacculi, perforation, enteritis, and occlusion. In women pressure may cause pain at the time of menstruation and a sensation of fullness and distention in the pelvic organs. Neuralgia of the sacral nerves may be caused by an overloaded sigmoid flexure. The fæces collect chiefly in the colon. Even in extreme grades of constipation it is rare to find dry fæces in the cæcum. The fæces may form large tumors at the hepatic or splenic flexures, or a sausage-like, doughy mass above the navel, or an irregular lumpy tumor in the left inguinal region. In old persons the sacculi of the colon become distended and the scybala may remain in them and undergo calcification, forming enteroliths.

In cases with prolonged retention the fæcal masses become channeled and

can't accurately!

Rohrstamm. - Therapie der Hyperemesis.. aug. 15.
Nahrungsaufnahme -
allergies Erbrechen
substituta milk + milk foods
(casein)

diarrhœa may occur for days before the true condition is discovered by rectal or external examination. In women who have been habitually constipated attacks of diarrhœa with nausea and vomiting should excite suspicion and lead to a thorough examination of the large bowel. Fever may occur in these cases, and Meigs has reported an instance in which the condition simulated typhoid fever.

Captivated by the theories of Metchnikoff we have been for some years on the crest of a colonic wave, and intestinal toxæmia has been held responsible for many of the worst of the ills that flesh is heir to, more particularly arterio-sclerosis and old age. The seniles and preseniles of two continents have been taking sour milk and lacto-bacillary compounds, to the great benefit of the manufacturing chemists! But the fad is passing, not, I hope, to be replaced by one even more serious, in which operation is advised for every case of severe intestinal stasis.

Constipation in infants is a common and troublesome disorder. The causes are congenital, dietetic, and local. There are instances in which the child is constipated from birth and may not have a natural movement for years, and yet thrive and develop. There are cases of enormous dilatation of the large bowel with persistent constipation. The condition appears sometimes to be a congenital defect. In some of these patients there may be constricting bands, or, as in a case of Cheever's, a congenital stricture.

Dietetic causes are more common. In sucklings it often arises from an unnatural dryness of the small residue which passes into the colon, and it may be very difficult to decide whether the fault is in the mother's milk or in the digestion of the child. Most probably it is in the latter, as some babies may be persistently costive on natural or artificial foods. Deficiency of fat in the milk is believed by some writers to be the cause. In older children it is of the greatest importance that regular habits should be enjoined. Carelessness on the part of the mother in this matter often lays the foundation of troublesome constipation in after life. Impairment of the contractility of the intestinal wall in consequence of inflammation, disturbance in the normal intestinal secretions, and mechanical obstruction by tumors, twists, and intussusception are the chief local causes.

Treatment.—Much may be done by systematic habits, particularly in the young. The patient should go to stool at a fixed hour every day, whether there is desire or not, and the desire should always be granted. Exercise in moderation is helpful. In stout persons and in women with pendulous abdomens the muscles should have the support of a bandage. Friction or regularly applied massage is invaluable in the more chronic cases. A good substitute is a metal ball weighing from four to six pounds, which may be rolled over the abdomen every morning for five or ten minutes. The diet should be light, with plenty of fruit and vegetables, particularly salads and tomatoes. Oatmeal is usually laxative, though not to all; brown bread is better than that made from fine white flour. Of liquids, water and aërated mineral waters may be taken freely. A tumblerful of hot or cold water on rising, taken slowly, is efficacious in many cases. A glass of hot water at night may also be tried alone. A pipe or a cigar after breakfast is with many men an infallible remedy.

When the condition is not very obstinate it is well to try to relieve it by hygienic and dietetic measures. If drugs must be used they should be the milder saline laxatives or the compound liquorice powder. Enemata are often necessary, and it is much preferable to employ them early than to constantly use purgative pills. Glycerine either in the form of suppository or as a small injection is very valuable. Half a drachm of boric acid placed within the rectum is sometimes efficacious. The injections of tepid water, with or without soap, may be used for a prolonged period with good effect and without damage. The patient should be in the dorsal position with the hips elevated, and it is best to let the fluid flow in slowly from a fountain syringe.

The usual remedies employed are often useless in the constipation associated with contracted bowel. A very satisfactory measure is the olive or cotton seed oil injection, as recommended by Kussmaul. The patient lies on the back with the hips elevated, and with a cannula and tube from 15 to 20 ounces of [illegible] oil are allowed to flow slowly (or are injected) into the bowel. The operation should take at least fifteen minutes. This may be repeated every day until the intestine is cleared, and subsequently a smaller injection every few days will suffice. In the cases with a spastic colon the injection of oil at bedtime, which is retained during the night, is often effectual.

There are various drugs which are of special service, particularly the combination of ipecacuanha, nux vomica, or belladonna, with aloes, or podophyllin. Cascara sagrada, phenolphthalein, and agar agar are useful. Persistent effort should be made to reduce the dosage by attention to hygienic measures. In anæmia and chlorosis, a sulphur confection taken in the morning, and a pill of iron, rhubarb, and aloes throughout the day, are very serviceable. Certain very severe cases are benefited by "short-circuiting," the lower end of the ileum being joined to the lower end of the colon.

In children the indications should be met, as far as possible, by hygienic and dietetic measures. In the constipation of sucklings a change in the diet of the mother may be tried, or from one to three teaspoonfuls of cream may be given before each nursing. In artificially fed children the top milk with the cream should be used. Drinking of water, barley water, or oatmeal water will sometimes obviate the difficulty. If laxatives are required, simple syrup, manna, or olive oil may be sufficient. The conical piece of soap, so often seen in nurseries, is sometimes efficacious. Massage along the colon may be tried. Small injections of cold water may be used. Large injections should be avoided, if possible. If it is necessary to give a laxative by the mouth, castor oil or the fluid magnesia is the best. The saline purgatives appear to act by increasing the muscular and glandular activity of the bowel. If there are signs of gastro-intestinal irritation, rhubarb and soda or gray powder may be given. In older children the diet should be carefully regulated.

VI. ENTEROPTOSIS

(*Glénard's Disease*)

Definition.—"Dropping of the viscera," visceroptosis, is not a disease, but a symptom group characterized by looseness of the mesenteric and

Intestinal Stasis Kellogg's Battle Creek June 30. 17

1. Low protein milk & diet esp. fruits, fresh veg. whole grain preps.
2. Bran or agar-agar at every meal. esp. veg tomatoes, lettuce, celery
3. ½-1½ oz. Liq. petrolatum at each meal. fruit always tonic.
4. Abd. massage & exercises

Occ. whole diet of green veg. rare rewarded with bran gruyan-agar.
5. enema daily if nec. tepid water w/ a few drops of
Specific colon-bacillus emulsion. B. alcaligenes.

In some cases chronic putrefaction
which melts at temperature into heat. 40°.

peritoneal attachments, so that the stomach, the intestines, particularly the transverse colon, the liver, the kidneys, and the spleen occupy an abnormally low position in the abdominal cavity.

Symptoms and Physical Signs.— It is important to recognize two groups of cases. In one the splanchnoptosis follows the loss of normal support of the abdominal wall in consequence of repeated pregnancies or recurring ascites. The condition may be extreme without the slightest distress on the part of the patient.

The second and more important group occurs usually in young persons, who present, with splanchnoptosis, the features of more or less marked neurasthenia.

In the first group inspection of the abdomen shows a very relaxed abdominal wall, and, as a rule, the lineæ albicantes of recurring pregnancies. Peristalsis of the intestines may be seen, and in extreme cases the outlines of the stomach itself with its waves of peristalsis. On inflating the stomach with carbonic-acid gas the organ stands out with great prominence, and the lesser and greater curvatures are seen, the latter extending perhaps a hand's breadth below the level of the navel. The waves of peristalsis are feeble and without the vigor and force of those seen in the stomach dilated from stricture of the pylorus. The condition of descensus ventriculi with atony is best studied in this group of cases. An important point to remember is that it may exist in an extreme grade without symptoms.

In the other group is embraced a somewhat motley series of cases, in which, with a pronounced nervous or, as we call it now, neurasthenic basis, there are displacements of the viscera *with symptoms*. The patients are usually young, more frequently women than men, and of spare habit. The condition may follow an acute illness with wasting. They complain, as a rule, of dyspepsia, throbbing in the abdomen, and dragging pains or weakness in the back, and inability to perform the usual duties of life. A very considerable proportion of all the cases of neurasthenia present the local features of enteroptosis. When preparing for the examination one notices usually an erythematous flushing of the skin; the scratch of the nail is followed instantly by a line of hyperæmia, less often of marked pallor. The pulsation of the abdominal aorta is readily seen.

Radiography has given much information of the position of the viscera and the patients should be examined carefully after a bismuth meal. The stomach is vertically placed and reaches far below the navel; its motility may be normal, but there may be stasis from associated pyloric spasm or from kinking of the duodenum. Inflated with gas the outlines may be seen through the thin skin. Clapotâge or splashing is usually distinct.

Nephroptosis, or displacement of the kidney, is one of the most constant phenomena in enteroptosis. It is well, perhaps, to distinguish between the kidney which one can just touch on deep inspiration—palpable kidney—one which is freely movable, and which on deep inspiration descends so that one can put the fingers of the palpating hand above it and hold it down, and, thirdly, a floating kidney, which is entirely outside the costal arch, is easily grasped in the hand, readily moved to the middle line, and low down toward the right iliac fossa. It is held by some that the designation floating kidney should be restricted to the cases in which there is a meso-nephron,

but this is excessively rare, while extreme grades of renal mobility are common. Some of the more serious sequences of movable kidney, namely, Dietl's crises and intermittent hydronephrosis, will be considered with diseases of the kidney.

Displacement of the liver is very much less common. In thin women who have laced, the organ is often tilted forward, so that a very large surface of the lobes comes in contact with the abdominal wall; it is a very common mistake under these circumstances to think that the organ is enlarged. Dislocation of the liver itself will be considered later.

Mobility of the spleen is sometimes very marked in enteroptosis. In an extreme grade it may be found in almost any region of the abdomen. It is very frequently mistaken for a fibroid or ovarian tumor. A considerable proportion of the cases come first under the care of the gynecologist.

There is usually much relaxation of the mesentery and of the peritoneal folds which support the intestines. The colon is displaced downward (coloptosis), with consequent kinking at the flexures. The descent may be so low that the transverse colon is at the brim of or even in the pelvis. It may indeed be fixed or bent in the form of a V. It is frequently to be felt, as Glénard states, as a firm cord crossing the abdomen at or below the level of the navel. This kinking may take place not only in the colon, but at the pylorus, where the duodenum passes into the jejunum, and where the ileum enters the cæcum.

The explanation of the phenomena accompanying enteroptosis is by no means easy. It has been suggested by Glénard and others that overfilling of the splanchnic vessels in consequence of displacements and kinking accounts for the feelings of exhaustion and general nervousness. In a large proportion of the cases, however, no symptoms occur until after an illness or some protracted nervous strain.

Treatment.—In a majority of all cases four indications are present: To treat the existing neurasthenia, to relieve the nervous dyspepsia, to overcome the constipation, and to afford mechanical support to the organs. Three of these are considered under their appropriate sections. In cases in which the enteroptosis has followed loss in weight after an acute illness or worries and cares an important indication is to fatten the patient.

A well-adapted abdominal bandage is one of the most important measures in enteroptosis. In many of the milder grades it alone suffices. I know of no single simple measure which affords relief to distressing symptoms in so many cases as the abdominal bandage. It is best made of linen, should fit snugly, and should be arranged with straps so that it can not ride up over the hips. A special form must be used, as will be mentioned later, for movable kidney. In some cases support may be given by the use of adhesive strapping. Some of the more aggravated types of enteroptosis are combined with such features of neurasthenia that a rigid Weir Mitchell treatment is indicated. In a few very refractory cases surgical interference may be called for.

And, lastly, the physician must be careful in dealing with the subjects of enteroptosis not to lay too much stress on the disorder. It is well never to tell the patient that a kidney is movable; the symptoms may date from a knowledge of the existence of the condition.

warm. sling. legs ... pressure pain over colic area

causes pain. - Avoid ... open with patient standing. Then up ... bend. knees pain will ... in trunk position. lifts up abdm. however no pressure ... bend ... returns if ... with ...

Exercises ... abdm. muscles ... & teach abdm. breath.

1). flex knees (unbend) ... sling expiration while ... abdm. walls.

2). teach to pull up ... while expiring.

3) Resistance to pulling up knees ... 2.

4) ... legs straight ... over other ... contract abdm. muscles while expiring

... Pelvis should not ...

Movements after each meal due to a very active gastro-colic reflex
(3 or 4 large movements often each day) Soft or fecal vomiting after
each meal.

Bowels. "Regularity" only by specialized neuromuscular [illegible]

VII. MISCELLANEOUS AFFECTIONS

I. MUCOUS COLITIS

Known by various names, such as *membranous enteritis, tubular diarrhœa, mucous colic,* and *myxoneurosis intestinalis,* this remarkable disease has been recognized for several centuries. An exhaustive description of it is given by Woodward in vol. ii of the Medical and Surgical Reports of the Civil War. The passage of mucus in large quantities from the bowel is met with, *first,* in catarrh of the intestine, due to various causes. It is not uncommon in children, and may be associated with disturbances of digestion and slight colic. *Secondly,* in local disease or irritation of the bowel, in cancer of the colon and of the rectum. In tubo-ovarian disease much mucus and slime may be passed. *Thirdly,* true mucous colitis, a secretion neurosis of the large intestine met with particularly in nervous and hysterical patients. It is more common in women than in men. It has increased greatly of late years, and has become the fashionable complaint, displacing neuritis to a great extent. There is an abnormal secretion of a tenacious mucus, which may be slimy and gelatinous, like frog-spawn, or it is passed in strings or strips, more rarely as a continuous tubular membrane. I have twice seen this membrane *in situ,* closely adherent to the mucosa, but capable of separation without any lesion of the surface. Microscopically the casts are mucoid, of a uniform granular ground substance through which there are remnants of cells, some of which have undergone a definite hyaline transformation. Triple phosphate, cholesterin, and fatty crystals are present, and occasionally fine, sand-like concretions. The epithelium of the mucosa seems to be intact.

Symptoms.—In a large proportion of all the cases the subjects are nervous in greater or less degree. Some cases have had hysterical outbreaks, and there may be hypochondriasis or melancholia. The patients are self-centred and often much worried about the mucous stools. Some of the cases are among the most distressing with which we have to deal, invalids of ~~from ten to twenty~~ many years' standing, neurasthenic to an extreme degree, with recurring attacks of pain and the passage of large quantities of mucus or even of intestinal casts.

In many cases the attacks may come on in paroxysms, associated with colicky pains, or occasionally crises of the greatest severity, so that appendicitis may be suspected. Emotional disturbances, worry of all sorts, or an error in diet may bring on an attack. Constipation is a special feature in many cases. Sometimes there are attacks of nervous diarrhœa.

While the disease is obstinate and distressing, it is rarely serious, though Herringham states that he knew of three cases of mucous colitis in which death occurred suddenly, in all with great pain in the left side of the abdomen. The abdomen itself is rarely distended. There is often a very painful spot just between the navel and the left costal border, tender on pressure, and sometimes the paroxysms of pain seem centred in this region. A spastic condition of the colon frequently exists and is easily recognized by palpation.

Diagnosis.—The ~~diagnosis~~ is rarely doubtful, but it is important not to

mistake the membranes for other substances; thus, the external cuticle of asparagus and undigested portions of meat or sausage-skins sometimes assume forms not unlike mucous casts, but microscopic examination will quickly differentiate them. Mucous colitis with severe pain may be mistaken for appendicitis.

Treatment.—Drugs are of little value. It is quite useless to give bismuth and so-called intestinal remedies. First the basic neurasthenic state is to be dealt with, and this may suffice for a cure. Secondly, daily irrigations of the colon through a long tube—one to two pints of warm alkaline fluid. At Plombières, Harrogate, and other spas this treatment is most successfully carried out. The injection of olive oil at bedtime is sometimes helpful. It should be retained during the night. Thirdly, the coarser sorts of food which leave a large residue should be eaten, and, lastly, should these measures fail, the question of opening the colon or irrigating through the appendix may be considered.

II. DILATATION OF THE COLON

There are four groups of cases. In the first the distention is entirely gaseous, and occurs not infrequently as a transient condition. In many cases it has an important influence, inasmuch as it may be extreme, pushing up the diaphragm and seriously impairing the action of the heart and lungs. It is an occasional cause of sudden heart-failure. In pneumonia and other acute diseases this inflation of the colon may be extreme.

In the second group are the cases in which the distention of the colon is caused by solid substances, as fæcal matter, occasionally by foreign bodies introduced from without, and more rarely by gall-stones. In institutions, particularly in insane asylums, it is not infrequent to find the aged with great distention of the colon.

When, thirdly, the dilatation is due to an organic obstruction in front of the dilated gut, the colon may reach a very large size. These cases are common enough in malignant tumors and sometimes in volvulus. Dilatation of the sigmoid flexure occurs particularly when this portion of the bowel is congenitally very long. In such cases the bowel may be so distended that it occupies the greater part of the abdomen, pushing up the liver and the diaphragm. An acute condition is sometimes caused by a twist in the meso-colon. And, fourthly—

Idiopathic Dilatation.—Hirschsprung's disease. The cases are not uncommon, occurring in children and in young adults. The sigmoid flexure alone or the entire colon is involved, and the size may be colossal. In Formad's case the circumference of the colon was from fifteen to thirty inches, and the weight of the contents forty-seven pounds. The origin is obscure. In some the condition is congenital, and the dilatation and hypertrophy increase progressively; in others there is an unusually long sigmoid flexure; in others again narrowing of the terminal portion of the descending colon or a valve-like structure has been found. The *symptoms* are very definite—constipation, an enlarged abdomen, attacks of pain with increasing distention, and then diarrhœa, either natural or induced, with relief. Such attacks may occur from birth and continue to the twentieth or thirtieth year. The abdominal picture is distinctive—the great enlargement of the upper half of

note - remember finding pus

Lynch v McFarland [illegible] dec 13. 16

boy [illegible] purulent & hemorrhagic [illegible] discharge, blood, mucus, pus. [illegible]

Shortly [illegible] & [illegible]

Trachoma. [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

Tr. [illegible] - in acute purulent [illegible]

local Tr. [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

Pot permang. 1-5000 w hyd. peroxide. Zit loi great.

-

black or brown acid like particles
some Cz or Mg. Phosphate - some may be resin or amino-acid.

the abdomen, the spreading of the costal arch, the remarkable length from the ensiform cartilage to the navel, and in the attacks the coils of the colon stand out prominently, and even the longitudinal bands may be seen.

The outlook is uncertain. Medical treatment is of little avail. I have seen one case in a young child in which scrupulous care of the bowels seemed to check the progress; but, as a rule, it is a progressive malady for which surgery alone offers complete relief. Resection of the enlarged colon has now been done in a good many cases with success. Colotomy gives relief; colostomy has also been successful. Of 44 cases treated surgically, 15 were completely cured and 7 were improved (Finney).

III. INTESTINAL SAND

"Sable Intestinal."—There are two groups of cases in which sand-like material is passed with the stools. The *false*, in which it is made up of the remains of vegetable food and fruits which have resisted digestion or which have become encrusted with earthy salts. *True* intestinal sand of animal origin, gritty fine particles, usually gray or colorless, sometimes dark, is formed in the bowel and is made up largely of lime salts. In mucous colitis this material may be passed at intervals for months.

IV. DIVERTICULITIS—PERISIGMOIDITIS

In the lower part of the descending colon and in the sigmoid flexure diverticula occur, sometimes congenital, sometimes acquired, most commonly in women and in association with constipation. Of 81 cases collected by Telling, 53 were in males. They are prone to form at the site of the appendices epiploicæ. Intestinal obstruction, acute gangrene, perforation with the formation of abscess, peritonitis, vesico-colic fistula, and metastatic suppuration are occasional complications. In acute cases left-sided appendicitis is diagnosed, while in the chronic cases the mimicry of cancer is very close. The cases are more common than we have heretofore supposed. Resection of the affected portion of the colon has been successfully performed.

V. AFFECTIONS OF THE MESENTERY

Hæmorrhage (*Hæmatoma*).—Instances in which the bleeding is confined to the mesenteric tissues are rare; more commonly the condition is associated with hæmorrhagic infiltration of the pancreas and with retroperitoneal hæmorrhage. It occurs in rupture of aneurisms, either of the abdominal aorta or of the superior mesenteric artery, in malignant forms of the infectious fevers, small-pox, and, lastly, in individuals in whom no predisposing conditions exist.

Affections of the Mesenteric Vessels.—(*a*) Aneurism (see under Arteries).

(*b*) Embolism and Thrombosis.—*Infarction of the Bowel.*—When the mesenteric vessels are blocked by emboli or thrombi the condition of infarction follows in the territory supplied, which may pass on to gangrene or to perforation and peritonitis. If the superior mesenteric artery is blocked

the result is fatal. In the veins the thrombosis may be primary, following infective processes in the intestines, particularly about the appendix, or it occurs in cachectic states. Secondary thrombosis is met with in cirrhosis of the liver, syphilis, and pylephlebitis, or may result from the stasis caused by arterial emboli. Jackson, Porter, and Quimby have made an exhaustive study of 30 Boston cases, and have collected 214 cases. They recognize two groups—acute and chronic. In the former the onset is sudden, with colic, nausea, vomiting, and a bloody diarrhœa, so that the picture is one of acute obstruction. The abdomen becomes distended and death occurs in collapse within a few days. In the chronic cases the onset is insidious, and there may be no symptoms referable to the abdomen. Of the 214 cases, 64 per cent. were in men. The diagnosis is extremely difficult, and the acute cases are usually regarded as obstruction. Exploratory operation has been made in 47 cases, 4 of which have recovered. In J. W. Elliot's successful case 48 inches of the bowel were resected. In the horse, infarction of the intestine, commonly in connection with the verminous aneurisms of the mesenteric arteries, is the usual cause of colic.

Diseases of the Mesenteric Veins.—Dilatation and sclerosis occur in cirrhosis of the liver. In instances of prolonged obstruction there may be large saccular dilatations with calcification of the intima, as in a case of obliteration of the venæ portæ described by me. Suppuration of the mesenteric veins is not rare, and occurs usually in connection with pylephlebitis. The mesentery may be much swollen and is like a bag of pus, and it is only on careful dissection that one sees that the pus is really within channels representing extremely dilated mesenteric veins.

Disorders of the Chyle Vessels.—Varicose, cavernous, and cystic chylangiomata are met with in the mucosa and submucosa of the small intestine, occasionally of the stomach. Extravasation of chyle into the mesenteric tissue is sometimes seen. Chylous cysts are found. I saw one the size of an egg at the root of the mesentery. Bramann records a case in a man aged sixty-three, in which a cyst of this kind the size of a child's head was healed by operation. There is an instance on record of a congenital malformation of the thoracic duct, in which the receptaculum formed a flattened cyst which discharged into the peritoneum, and a chylous ascitic fluid was withdrawn on several occasions. Homans reported the case of a girl who, from the third to the thirteenth year, had an enlarged abdomen. Laparotomy showed a series of cysts containing clear fluid. They were supposed to be dilated lymph vessels connected with the intestines.

Cysts of the Mesentery.—They may be either dermoid, hydatid, serous, sanguineous, or chylous. They occur at any portion of the mesentery, and range from a few inches in diameter to large masses occupying the entire abdomen. They are frequently adherent to the neighboring organs, to the liver, spleen, uterus, and sigmoid flexure.

The symptoms usually are those of a progressively enlarging tumor in the abdomen. Sometimes a mass develops rapidly, particularly in the hæmorrhagic forms. Colic and constipation are present in some cases. The general health, as a rule, is well maintained in spite of the progressive enlargement of the abdomen, which is most prominent in the umbilical region. Mesenteric cysts may persist for many years, even ten or twenty.

(Hodgson Blankenhorn)

Bilirubin & bile salts may both be in blood & not in urine.

Plasma may absorb & retain abnormal pigment & yield none to kidneys or tissues. — Adsorption of bile salts not so marked as bile pigment.

Impairment enzymic especially bile salts in plasma & not in urine.

may be cholaemic without cholemia.

'Dissociated jaundice' — i.e. bile pigs. & salts reach circ. independently

kidneys may excrete one but not the other.

If bile salts & not bile pigs. in plasma = genuine dissoc. jaun. of hep. origin

no [illegible] that bile pig. clears by kidney bile salts retained in plasma.

If sep. by kidney — always bile pig. in plasma & not bile salts.

Surgical hemolytic jaund. & in simple jaun. with renal dissoc. was

bile pig. without bile salts in plasma.

So "hemolytic icterus" = bilirubin in blood without bile salts when

bilirubin formed excessively.

The diagnosis is extremely uncertain, and no single feature is in any way distinctive. The important signs are: the great mobility, the situation in the middle line, and the zone of tympany in front of the tumor. Of these, the second is the only one which is at all constant, as when the tumors are large the mobility disappears, and at this stage the intestines, too, are pushed to one side. It is most frequently mistaken for ovarian tumor. Movable kidney, hydronephrosis, and cysts of the omentum have also been confused with it. In certain instances puncture may be made for diagnostic purposes, but it is better to advise laparotomy for the purpose of drainage, or, if possible, enucleation may be practiced.

H. DISEASES OF THE LIVER

I. JAUNDICE

(*Icterus*)

Definition.—Jaundice or icterus is a condition characterized by coloration of the skin, mucous membranes, and fluids of the body by the bile-pigment.

Like albuminuria, jaundice is a symptom and not a disease, and is met with in a variety of conditions.

1. OBSTRUCTIVE JAUNDICE

The chief causes of obstructive jaundice are: (1) Obstruction by foreign bodies within the ducts, as gall-stones and parasites; (2) by inflammatory tumefaction of the duodenum or of the lining membrane of the duct; (3) by stricture or obliteration of the duct; (4) by tumors closing the orifice of the duct or growing in its interior; (5) by pressure on the duct from without, as by tumors of the liver itself, of the stomach, pancreas, kidney, or omentum; by pressure of enlarged glands in the fissures of the liver, and, more rarely, of abdominal aneurism, fæcal accumulation, or the pregnant uterus.

In these case of extra-hepatic or obstructive jaundice the pressure within the biliary capillaries, usually low, becomes increased and the bile is absorbed by the lymphatics of the liver and not by the blood capillaries. To these causes some add lowering of the blood pressure in the portal system so that the tension in the smaller bile-ducts is greater than in the blood-vessels. For this view, however, there is no positive evidence. In this class may perhaps be placed the cases of jaundice from mental shock or depressed emotions, which "may conceivably cause spasm and reversed peristalsis of the bile-duct" (W. Hunter).

General Symptoms of Obstructive Jaundice.—(*a*) *Icterus, or tinting of the skin and conjunctivæ.* The color ranges from a lemon-yellow in catarrhal jaundice to a deep olive-green or bronzed hue in permanent obstruction. In some instances the color of the skin is greenish black, the so-called "black jaundice." Except the central nervous system, all of the tissues are stained.

(*b*) In the more chronic forms *pruritus* is a most distressing symptom. There is a curious preicteric itching, which Riessman thinks is suggestive of cancer, but I have seen it most marked in gall-stone cases. Sweating is common, and may be curiously localized to the abdomen or to the palms of the hands. Lichen, urticaria, and boils may occur. *Xanthoma multiplex* is rare. Only two cases have occurred under my observation. Usually in the flat form, rarely nodular, they are most common in the eyelids and on the hands and feet. They may be very numerous over the whole body. Occasionally the tumors are found in the bile duct. After persisting for years they may disappear. In very chronic cases telangiectases develop in the skin, sometimes in large numbers over the body and face, occasionally on the mucous membrane of the tongue and lips, forming patches of a bright red color from 1 to 2 cm. in breadth.

(*c*) The *secretions* are colored with bile-pigment. The sweat tinges the linen; the tears and saliva and milk are rarely stained. The expectoration is not often tinted unless there is inflammation, as when pneumonia coexists with jaundice. The urine may contain the pigment before it is apparent in the skin or conjunctiva. The color varies from light greenish yellow to a deep black-green. In cases of jaundice of long standing or great intensity the urine usually contains albumin and always bile-stained tube-casts.

(*d*) *No bile passes into the intestine.* The stools therefore are of a pale drab or slate-gray color, and usually very fetid and pasty. The "clay-color" of the stools is also in part due to the presence of undigested fat which, according to Müller, may be increased from 7 to 10 per cent., which is normal, to 55 or 78.5 per cent. There may be constipation; in many instances, owing to decomposition, there is diarrhœa.

(*e*) *Slow pulse.* The heart's action may fall to 40, 30, or even to 20 per minute. It is particularly noticeable in the cases of catarrhal and recent jaundice, and is not as a rule an unfavorable symptom. Whether this is due to interrupted conductivity or to direct poisoning of the auriculo-ventricular bundle has not been determined. It occurs only in the early stages of jaundice. At this time bile acids pass into the blood, but are produced in very small quantities when jaundice is established. The respirations may fall to 10 or even to 7 per minute. Xanthopsia, or yellow vision, may occur.

(*f*) *Hæmorrhage.* The tendency to bleeding in chronic icterus is a serious feature. It has been shown that the blood-coagulation time may be much retarded, and instead of from three minutes and a half to four minutes and a half we have found it in some cases as late as eleven or twelve minutes. This is a point which should be taken account of by surgeons, inasmuch as incontrollable hæmorrhage is a well-recognized accident in operating upon patients with chronic obstructive jaundice. Purpura, large subcutaneous extravasations, more rarely hæmorrhages from the mucous membranes, occur in protracted jaundice, and in the more severe forms.

(*g*) *Cerebral symptoms.* Irritability, great depression of spirits, or even melancholia may be present. In any case of persistent jaundice special nervous phenomena may develop and rapidly prove fatal—such as sudden coma, acute delirium, or convulsions. Usually the patient has a rapid pulse, slight fever, and a dry tongue, and he passes into the so-called "typhoid state." These features are not nearly so common in obstructive as in febrile jaundice,

Digestive leukaemia — digestive organs — normal — Blood cannot be distinguished by bacteriological — Bright. called blood cannot — Lymphocytes — fat particles can be found in blood —

If total obstruction of bile passages — no absorption of fat into blood.

If jaundice from retention of bile pigment alone — absorption not modified

" " " " " cells — fat does not appear in blood

Dissociation of bile + retention of part of bile demands — demonstrated by Dig. Leipsonia. Liver must be responsible for this.

Summary: Shut off bile — did not influence absorption of fat from food — viz. suggests that liver [illegible] when [illegible]

and in some cases/

but they not infrequently terminate a chronic icterus in whatever way produced. The group of symptoms has been termed *cholæmia*, or, on the supposition that cholesterin is the poison, *cholesteræmia;* but its true nature has not been determined. In some of the cases the symptoms may be due to uræmia.

2. TOXÆMIC AND HÆMOLYTIC JAUNDICE

The term hæmatogenous jaundice was formerly applied to this group in contradistinction to the hepatogenous jaundice, associated with manifest obstructive changes in the bile-passages. The toxic jaundice cases are essentially obstructive in origin, and it is doubtful whether there are any true non-obstructive cases. The manner in which the jaundice is produced in these cases has been experimentally worked out by Stadelmann and Afanassiew. The obstruction is due to the extreme viscidity of the bile associated with a mild angiocolitis. The sequence of events is as follows: Destruction of blood by hæmolysis; liberation of hæmoglobin with increased formation and excretion of bile pigments (polychromia); increased viscidity of the bile, which, at the low pressure at which the bile is excreted, causes a temporary obstruction, with reabsorption of the bile and jaundice; finally the bile loses its viscid character, the flow is reëstablished, and the jaundice disappears. Stadelmann found that a similar explanation applies to other varieties of jaundice associated with increased blood destruction. For this type the name "hæmohepatogenous" jaundice has been suggested. Rolleston refers to them as cases of "intrahepatic" jaundice. Hunter groups the causes as follows: 1. Jaundice produced by the action of poisons, such as toluylendiamin, phosphorus, arsenic, snake-venom. 2. Jaundice met with in various specific fevers and conditions, such as yellow fever, malaria, (remittent and intermittent), pyæmia, relapsing fever, typhus, enteric fever, scarlatina. 3. Jaundice met with in various conditions of unknown but more or less obscure infective nature, and variously designated as epidemic, infectious, febrile, malignant jaundice, icterus gravis, Weil's disease, acute yellow atrophy.

The symptoms are not nearly so striking as in the obstructive variety. The bile is present in the stools. The skin has in many cases only a slight lemon tint. The urine may contain no bile-pigment, but the urinary pigments are considerably increased. In the severer forms, as in acute yellow atrophy, the color may be more intense, but in malaria and pernicious anæmia the tint is usually light. The constitutional disturbance may be very profound, with high fever, delirium, convulsions, suppression of urine, black vomit, and cutaneous hæmorrhages. In certain cases of hæmolytic jaundice the fragility of the red corpuscles is greatly increased and they may be smaller than normal (Widal, Chauffard) and show granular degeneration. This is particularly the case in the group of congenital icterus with enlarged spleen.

3. HEREDITARY ICTERUS

A family form of icterus has long been known. We must recognize, indeed, several groups. First, icterus neonatorum, as in the remarkable instance described by Glaister (Lancet, March, 1879), in which a woman had eight children, six of whom died of jaundice shortly after birth; one of the cases had ste-

nosis of the common duct, which, as John Thomson has shown, is, with angiocholitis, a common lesion in this affection. Still more remarkable is it that the mother of this woman had twelve children, all of whom were icteric after birth, but the jaundice gradually disappeared. A brother of the woman had several children who also were jaundiced at birth. Glaister states that all of the children of Morgagni, fifteen in number, had icterus neonatorum. Secondly, the congenital acholuric icterus. Minkowski reported eight cases in three generations. The jaundice is slight, the stools are not clay colored, the urine has no bile pigment but contains urobilin, the general health is little if at all disturbed. Splenic enlargement is a marked feature. Many cases have now been reported of this Minkowski type, nearly all in family groups, but Chauffard has met with a case without hereditary basis and I have seen at least one case of the kind. No special changes have been found in the liver or bile passages. Thirdly, a group of cases with enlargement of the spleen and liver and marked constitutional disturbances, anæmia, dwarfing of stature, infantilism, and slight jaundice. Cases which have been described as Hanot's cirrhosis have occurred in two or three members of a family, and the jaundice has dated from early childhood.

~~Jaundice has been described in connection with the various fevers, malaria, yellow fever, and Weil's disease.~~ Two special affections may here receive consideration, the icterus of the new-born and acute yellow atrophy.

II. ICTERUS NEONATORUM

New-born infants are liable to jaundice, which in some instances rapidly proves fatal. A mild and a severe form may be recognized.

The *mild or physiological icterus* of the new-born is a common disease in foundling hospitals, and is not very infrequent in private practice. In 900 consecutive births at the Sloane Maternity icterus was noted in 300 cases (Holt). The discoloration appears early, usually on the first or second day, and is of moderate intensity. The urine may be bile-stained and the fæces colorless. The nutrition of the child is not usually disturbed, and in the majority of cases the jaundice disappears within two weeks. This form is never fatal. The cause of this jaundice is not at all clear. Some have attributed it to stasis in the smaller bile-ducts, which are compressed by the distended radicals of the portal vein. Others hold that the jaundice is due to the destruction of a large number of red blood-corpuscles during the first few days after birth.

The *severe form* of icterus in the new-born may depend upon (*a*) congenital absence of the common or hepatic duct, of which there are many instances on record; (*b*) congenital syphilitic hepatitis; and (*c*) septic poisoning, associated with phlebitis of the umbilical vein. This is a severe and fatal form, in which also hæmorrhage from the cord may occur.

Curiously enough, in contradistinction to other forms, the brain and cord may be stained yellow in icterus neonatorum, sometimes diffusely, more rarely in definite foci corresponding to the ganglion cells which have become deeply stained (Schmorl).

III. ACUTE YELLOW ATROPHY

(*Malignant Jaundice; Icterus Gravis*)

Definition.—An acute widespread autolytic necrosis of the liver cells of unknown origin, characterized by jaundice, toxæmia and a reduction in the volume of the liver.

Etiology.—The first authentic account was given by the famous old Paris doctor Ballonius—sometimes called the French Hippocrates (1538-1616). Bright gave a good description in 1836. It is a rare disease, as among 28,000 medical cases admitted to the Johns Hopkins Hospital in nearly twenty-three years there were only ~~three~~ cases. It varies in frequency in different countries, and seems to be ~~more~~ rare in the United States than in Germany and England. The majority of cases occur between the tenth and the fortieth year. Rolleston ~~has~~ collected 22 cases occurring within the first ten years of life.

Recent studies have thrown a good deal of light upon the subject; we now know that acute necrosis of the liver occurs under many conditions: (*a*) In the infections, syphilis, typhoid fever, diphtheria, septicæmia, these necroses may be widespread. (*b*) Non-bacterial poisons. The remarkable delayed chloroform poisoning is a hepatic necrosis resembling very closely acute yellow atrophy. Phosphorus produces a similar condition, and possibly mercury. (*c*) Autogenous poisons, produced in connection with pregnancy and parturition. The ordinary necrotic foci of the liver in pregnancy are the same kind but less in degree than those of acute yellow atrophy.

An exaggeration of any of these types may lead to a clinical condition which we call acute yellow atrophy. Its association with pregnancy is remarkable. More than one-half of the cases occur in women, and in a large proportion of these during the middle or latter half of pregnancy. The disease has followed a profound shock, or mental emotion. It occurs occasionally in syphilis and other acute infections, and there are cases of cirrhosis of the liver, particularly of the hypertrophic form, associated with diffuse necrosis, intense jaundice and toxæmia. We are as yet ignorant of the conditions under which the poisons, bacterial or metabolic, cause this widespread necrosis.

Morbid Anatomy.—The liver is greatly reduced in size, looks thin and flattened, and sometimes does not reach more than one-half or even one-third of its normal weight. It is flabby and the capsule is wrinkled. Externally the organ has a greenish-yellow color. On section the color may be yellowish-brown, yellowish-red, or mottled, and the outlines of the lobules are indistinct. The yellow and dark-red portions represent different stages of the same process—the yellow an earlier, the red a more advanced stage. The organ may cut with considerable firmness. Microscopically the liver-cells are seen in all stages of necrosis, and in spots appear to have undergone complete destruction, leaving a fatty, granular *débris* with pigment grains and crystals of leucin and tyrosin. Hæmorrhages occur between the liver-cells. There is a cholangitis of the smaller bile-ducts. Marchand, MacCallum, and others have described regenerative changes in the cases which do not run an acute course.

The other organs show extensive bile-staining, and there are numerous hæmorrhages. The kidneys may show marked granular degeneration of the epithelium, and usually there is fatty degeneration of the heart. In a majority of the cases the spleen is enlarged.

Symptoms.—In the initial stage there is gastro-duodenal catarrh, and at first the jaundice is thought to be of a simple nature. In some instances this lasts only a few days, in others two or three weeks. Then severe symptoms set in—headache, delirium, trembling of the muscles, and, in some instances, convulsions. Vomiting is a constant symptom, and blood may be brought up. Hæmorrhages occur into the skin or from the mucous surfaces; in pregnant women abortion may occur. The jaundice usually increases, coma sets in and gradually deepens until death. The body temperature is variable; in a majority of the cases the disease runs an afebrile course, though sometimes just before death there is an elevation. In some instances, however, there has been marked pyrexia. The pulse is usually rapid, the tongue coated and dry, and the patient is in a "typhoid state." There may be complete obliteration of the liver dulness. This is due to the flabby organ falling away from the abdominal walls and allowing the intestinal coils to take its place.

The urine is bile-stained and often contains tube-casts. Frequently albuminuria and occasionally albumosuria occur. Urea is markedly diminished. There is a corresponding increase in the percentage of nitrogen present as ammonia. Herter finds it may be increased from the normal 2 to 5 per cent. up to 17 per cent. The diminution in urea is probably partly due to the liver-cells failing to manufacture urea from ammonia, but it may also be in part due to organic acids seizing on the ammonia, and thus preventing the formation of urea out of the basic ammonia. Leucin and tyrosin are not constantly present; of 23 cases collected by Hunter, in 9 neither was found; in 10 both were present; in 3 tyrosin only; in 1 leucin only. The present view is that the leucin and tyrosin are derived from the liver-cells themselves as a result of their extensive destruction. In the majority of cases no bile enters the intestines, and the stools are clay-colored. The disease is almost invariably fatal. In a few instances recovery has been noted. I saw in Leube's clinic, at Würzburg, a case which was convalescent.

The duration and the type of the disease depend upon the extent and the rapidity of progress of the necrosis. Cases have lasted as long as forty days, while death has occurred as early as the second day. A sub-acute form has been described by Milne, a slow necrosis lasting many months, associated with jaundice—a protracted stage from which recovery is possible by regeneration of liver tissue, but consecutive cirrhosis is the rule.

Diagnosis.—Jaundice with vomiting, diminution of the liver volume, delirium, and the presence of leucin and tyrosin in the urine, form a characteristic and unmistakable group of symptoms. Leucin and tyrosin are not, however, distinctive. They may be present in cases of afebrile jaundice with slight enlargement of the liver.

It is not to be forgotten that any severe jaundice may be associated with intense cerebral symptoms. The clinical features in certain cases of hypertrophic cirrhosis are almost identical, but the enlargement of the liver, the more constant occurrence of fever, and the absence of leucin and tyrosin are distinguishing signs. Phosphorus poisoning may closely simulate acute yellow

atrophy, particularly in the hæmorrhages, jaundice, and the diminution in the liver volume, but the gastric symptoms are usually more marked, and leucin and tyrosin are stated not to occur in the urine.

Treatment.—No known remedies have any influence on the course of the disease. Theoretically, efforts should be made to eliminate the toxins before they produce their degenerative effects by free purgation and the use of subcutaneous and intravenous saline injections. Gastric sedatives may be used to allay the distressing vomiting.

IV. AFFECTIONS OF THE BLOOD-VESSELS OF THE LIVER

Anæmia.—On the post mortem table, when the liver looks anæmic, as in the fatty or amyloid organ, the blood-vessels, which during life were probably well filled, can be readily injected. There are no symptoms indicative of this condition.

Hyperæmia.—This occurs in two forms.

(*a*) Active Hyperæmia.—After each meal the rapid absorption by the portal vessels induces transient congestion of the organ, which, however, is entirely physiological; but it is quite possible that in persons who persistently eat and drink too much this active hyperæmia may lead to functional disturbance, or, in the case of drinking too freely of alcohol, to organic change. In the fevers an acute hyperæmia may be present.

The *symptoms* of active hyperæmia are indefinite. Possibly the sense of distress or fullness in the right hypochondrium, so often metioned by dyspeptics and by those who eat and drink freely, may be due to this cause. There are probably diurnal variations in the volume of the liver. In cirrhosis with enlargement the rapid reduction in volume after a copious hæmorrhage indicates the important part which hyperæmia plays even in organic troubles. It is stated that suppression of the menses or suppression of a hæmorrhoidal flow is followed by hyperæmia of the liver. Andrew H. Smith has described a case of periodical enlargement of the liver.

(*b*) Passive Congestion.—This is much more common and results from an increase of pressure in the efferent vessels or sub-lobular branches of the hepatic veins. Every condition leading to venous stasis in the right heart at once affects these veins.

In chronic valvular disease, in emphysema, cirrhosis of the lung, and in intrathoracic tumors mechanical congestion occurs and finally leads to very definite changes. The liver is enlarged, firm, and of a deep-red color; the hepatic vessels are greatly engorged, particularly the central vein in each lobule and its adjacent capillaries. On section the organ presents a peculiar mottled appearance, owing to the deeply congested hepatic and the anæmic portal territories; hence the term *nutmeg* which has been given to this condition. Gradually the distention of the central capillaries reaches such a grade that atrophy of the intervening liver-cells is induced. Brown pigment is deposited about the centre of the lobules and the connective tissue is greatly increased. In this cyanotic induration or cardiac liver the organ is large in the early stage, but later it may become contracted. Occasionally in this form the connective tissue is increased about the lobules as well, but the process usually extends from the sub-lobular and central veins.

The symptoms of this form are not always to be separated from those of the associated conditions. Gastro-intestinal catarrh is usually present and hæmatemesis may occur. The portal obstruction in advanced cases leads to ascites, which may precede the development of general dropsy. There is often slight jaundice, the stools may be clay-colored, and the urine contains bile-pigment.

On examination the organ is found to be increased in size. It may be a full hand's breadth below the costal margin and tender on pressure. It is in this condition particularly that we meet with pulsation of the liver. We must distinguish the communicated throbbing of the heart, which is very common, from the heaving, diffuse impulse due to regurgitation into the hepatic veins, in which, when one hand is upon the ensiform cartilage and the other upon the right side at the margin of the ribs, the whole liver can be felt to dilate with each impulse.

The indications for *treatment* in passive hyperæmia are to restore the balance of the circulation and to unload the engorged portal vessels. In cases of intense hyperæmia 18 or 20 ounces of blood may be directly aspirated from the liver, as advised by George Harley and practiced by many Anglo-Indian physicians. Good results sometimes follow this hepato-phlebotomy. The prompt relief and marked reduction in the volume of the organ which follow an attack of hæmatemesis or bleeding from piles suggest this practice. Salts administered by Matthew Hay's method deplete the portal system freely and thoroughly. As a rule, the treatment must be that of the condition with which it is associated.

Diseases of the Portal Vein.—(*a*) Thrombosis; Adhesive Pylephlebitis.—Coagulation of blood in the portal vein is met with in cirrhosis, in syphilis of the liver, invasion of the vein by cancer, proliferative peritonitis involving the gastro-hepatic omentum, perforation of the vein by gall-stones, and occasionally follows sclerosis of the walls of the portal vein or of its branches. In rare instances a complete collateral circulation is established, the thrombus undergoes the usual change, and ultimately the vein is represented by a fibrous cord, a condition which has been called *pylephlebitis adhesiva*. In a case of this kind which I dissected the portal vein was represented by a narrow fibrous cord; the collateral circulation, which must have been completely established for years, ultimately failed, ascites and hæmatemesis supervened and rapidly proved fatal. The diagnosis of obstruction of the portal vein can rarely be made. A suggestive symptom, however, is a *sudden* onset of the most intense engorgement of the branches of the portal system, leading to hæmatemesis, melæna, ascites, and swelling of the spleen.

Infarcts are not common in the liver and may be either anæmic or hæmorrhagic. They are met with in obstruction of the portal vessels, or of the portal and hepatic veins at the same time, occasionally in disease of the hepatic artery.

(*b*) Suppurative pylephlebitis will be considered in the section on abscess.

Affections of the hepatic vein are extremely rare. Dilatation occurs in cases of chronic enlargement of the right heart, from whatever cause produced. Emboli occasionally pass from the right auricle into the hepatic veins.

Stenosis of the orifices of the hepatic veins may occur as a primary lesion

with a special syndrome which has been described by Craven Moore—a progressive enlargement of the liver, signs of involvement of the inferior vena cava, and ascites.

Hepatic Artery.—Enlargement of this vessel is seen in cases of cirrhosis of the liver. It may be the seat of extensive sclerosis. Aneurism of the hepatic artery is rare, but instances are on record, and will be referred to in the section on arteries.

V. DISEASES OF THE BILE-PASSAGES AND GALL-BLADDER

I. ACUTE CATARRH OF THE BILE-DUCTS

(*Catarrhal Jaundice*)

Definition.—Jaundice due to swelling and obstruction of the terminal portion of the common duct.

Etiology.—General catarrhal inflammation of the bile-ducts is usually associated with gall-stones. The catarrhal process now under consideration is probably always an extension of a gastro-duodenal catarrh, and the process is most intense in the *pars intestinalis* of the duct, which projects into the duodenum. The mucous membrane is swollen, and a plug of inspissated mucus fills the diverticulum of Vater, and the narrower portion just at the orifice, completely obstructing the outflow of bile. It is not known how widespread this catarrh is in the bile-passages, and whether it really passes up the ducts. It would, of course, be possible to have a catarrh of the finer ducts within the liver, which some French writers think may initiate the attack, but the evidence for this is not strong, and it seems more likely that the terminal portion of the duct is always first involved. In the only instance which I have had an opportunity to examine post mortem the orifice was plugged with inspissated mucus, the common and hepatic ducts were slightly distended and contained a bile-tinged, not a clear, mucus, and there were no observable changes in the mucosa of the ducts.

This catarrhal or simple jaundice results from the following causes: (*a*) Duodenal catarrh, in whatever way produced, most commonly following an attack of indigestion. It is most frequently met with in young persons, but may occur at any age, and may follow not only errors in diet, but also cold, exposure, and malaria, as well as the conditions associated with portal obstruction, chronic heart-disease, and ~~Bright's disease~~ nephritis. (*b*) Emotional disturbances may be followed by jaundice, which is believed to be due to catarrhal swelling. Cases of this kind are rare and the anatomical condition is unknown. (*c*) Simple or catarrhal jaundice may occur in epidemic form. (*d*) Catarrhal jaundice is occasionally seen in the infectious fevers, such as pneumonia and typhoid fever. The nature of acute catarrhal jaundice is still unknown. It may possibly be an acute infection. In favor of this view are the occurrence in epidemic form and the presence of slight fever. The spleen, however, is not often enlarged. In only 4 out of 23 cases was it palpable.

Symptoms.—There may be neither pain nor distress, and the patient's friends may first notice the yellow tint, or the patient himself may observe it

in the looking-glass. In other instances there are dyspeptic symptoms and uneasy sensations in the hepatic region or pains in the back and limbs. In the epidemic form the onset may be more severe, with headache, chill, and vomiting. Fever is rarely present, though the temperature may reach 101° degrees, sometimes 102° degrees. All the signs of obstructive jaundice already mentioned are present, the stools are clay-colored, and the urine contains bile-pigment. The skin has a bright-yellow tint; the greenish, bronzed color is never seen in the simple form. I have once seen spider angiomata on the face in catarrhal jaundice. They disappeared in a few months. The pulse may be normal, but occasionally it is remarkably slow, and may fall to 40 or 30 beats in the minute, and the respirations to as low as 8 per minute. Sleepiness, too, may be present. The liver may be normal in size, but is usually slightly enlarged, and the edge can be felt below the costal margin. Occasionally the enlargement is more marked. As a rule the gall-bladder can not be felt. The spleen may be increased in size. The duration of the disease is from four to eight weeks. There are mild cases in which the jaundice disappears within two weeks; on the other hand, it may persist for three months or even longer. The stools should be carefully watched, for they give the first intimation of removal of the obstruction.

Diagnosis.—This is rarely difficult. The onset in young, comparatively healthy persons, the moderate grade of icterus, the absence of emaciation or of evidences of cirrhosis or cancer usually make the diagnosis easy. Cases which persist for two or three months cause uneasiness, as the suspicion is aroused that it may be more than simple catarrh. The absence of pain, the negative character of the physical examination, and the maintenance of the general nutrition are the points in favor of simple jaundice. There are instances in which time alone can determine the true nature of the case. The possibility of Weil's disease must be borne in mind in anomalous types.

Treatment.—The diet should be simple and the fats restricted. Measures should be used to allay the gastric catarrh, if it is present. A dose of calomel may be given, and the bowels kept open subsequently by salines. The patient should not be violently purged. Bismuth and bicarbonate of soda may be given, and the patient should drink freely of the alkaline mineral waters, of which Vichy is the best. Irrigation of the large bowel with cold water may be practiced. The cold is supposed to excite peristalsis of the gall-bladder and ducts, and thus aid in the expulsion of the mucus.

II. CHRONIC CATARRHAL ANGIOCHOLITIS

This may possibly occur also as a sequel of the acute catarrh. I have never met with an instance, however, in which a chronic, persistent jaundice could be attributed to this cause. A chronic catarrh always accompanies obstruction in the common duct, whether by gall-stones, malignant disease, stricture, or external pressure. There are two groups of cases:

With Complete Obstruction of the Common Duct.—In this form the bile-passages are greatly dilated, the common duct may reach the size of the thumb or larger, there is usually dilatation of the gall-bladder and of the ducts within the liver. The contents of the ducts and of the gall-bladder are a clear, colorless mucus. The mucosa may be everywhere smooth and not swollen. The

Daily Carriage of Letters should not exceed 56?

clear mucus is usually sterile. The patients are the subjects of chronic jaundice, usually without fever.

With Incomplete Obstruction of the Duct.—There is pressure on the duct or there are gall-stones, single or multiple, in the common duct or in the diverticulum of Vater. The bile-passages are not so much dilated, and the contents are a bile-stained, turbid mucus. The gall-bladder is rarely much dilated. In a majority of all cases stones are found in it.

The symptoms of this type of catarrhal angiocholitis are sometimes very distinctive. With it is associated most frequently the so-called hepatic intermittent fever, recurring attacks of chills, fever, and sweats. It is most important to bear in mind that the chills, fever, and sweats do not necessarily mean suppuration.

III. SUPPURATIVE AND ULCERATIVE ANGIOCHOLITIS

The condition is a diffuse, purulent angiocholitis involving the larger and smaller ducts. In a large proportion of all cases there is associated suppurative disease of the gall-bladder.

Etiology.—It is the most serious of the sequels of gall-stones. Occasionally a diffuse suppurative angiocholitis follows the acute infectious cholecystitis; this, however, is rare, since fortunately in the latter condition the cystic duct is usually occluded. Cancer of the duct, or foreign bodies, such as lumbricoids or fish bones, are occasional causes. There may be extension from a suppurative pylephlebitis. In rare instances suppurative cholangitis occurs in the acute infections, as pneumonia and influenza.

The common duct is greatly dilated and may reach the size of the index finger or the thumb; the walls are thickened, and there may be fistulous communications with the stomach, colon, or duodenum. The hepatic ducts and their extensions in the liver are dilated and contain pus mixed with bile. On section of the liver small abscesses are seen, which correspond to the dilated suppurating ducts. The gall-bladder is usually distended, full of pus, and with adhesions to the neighboring parts, or it may have perforated.

Symptoms.—The symptoms of suppurative cholangitis are usually very severe. A previous history of gall-stones, the development of a septic fever, the swelling and tenderness of the liver, the enlargement of the gall-bladder, and the leucocytosis are suggestive features. Jaundice is always present, but is variable. In some cases it is very intense, in others it is slight. There may be very little pain. There are progressive emaciation and loss of strength. In a recent case parotitis developed on the left side, which subsided without suppuration.

Ulceration, stricture, perforation, and fistulæ of the bile-passages will be considered with gall-stones.

IV. ACUTE INFECTIOUS CHOLECYSTITIS

Etiology.—Acute inflammation of the gall-bladder is usually due to bacterial invasion, with or without the presence of gall-stones. Three varieties or grades may be recognized: the catarrhal, the suppurative, and the phlegmonous. The condition is very serious, difficult to diagnose, often fatal, and may require for its relief prompt surgical intervention.

Acute non-calculous cholecystitis is a result of bacterial invasion. The colon bacillus, the typhoid bacillus, the pneumococcus and staphylococci and streptococci have been the organisms most often found. The frequency of gall-bladder infection in the fevers is a point already referred to, particularly in typhoid fever.

The association of appendix lesions with cholecystitis is interesting, fully 69 per cent. at the Mayo clinic; but this is not surprising in view of studies which show a normal appendix to be a rarity. There are indications, however, that chronic changes in this organ may reflexly disturb the mechanism of the secretion, storage, and outflow of bile.

Condition of the Gall-bladder.—The organ is usually distended and the walls tense. Adhesions may have formed with the colon or the omentum. In the acute stage the mucous membrane is swollen and the amount of mucin increased. As the process continues the mucosa becomes thickened, the epithelium desquamates, there are areas of necrosis, and the villi may be much hypertrophied and stand out, giving a strawberry appearance. With the obstruction of the duct and pyogenic infection there may be acute necrotic cholecystitis, with rapid perforation, or a more chronic purulent cholecystitis —empyema of the gall-bladder.

Symptoms.—Severe paroxysmal pain is, as a rule, the first indication, most commonly in the right side of the abdomen in the region of the liver. It may be in the epigastrium or low down in the region of the appendix. "Nausea, vomiting, rise of pulse and temperature, prostration, distention of the abdomen, rigidity, general tenderness becoming localized" usually follow (Richardson). In this form, without gall-stones, jaundice is not often present. The local tenderness is extreme, but it may be deceptive in its situation. Associated probably with the adhesion and inflammatory processes between the gall-bladder and the bowel are the intestinal symptoms, and there may be complete stoppage of gas and fæces; indeed, the operation for acute obstruction has been performed in several cases. The distended gall-bladder may sometimes be felt. As a sequel there may be purulent distention or empyema.

Diagnosis.—The diagnosis is by no means easy. The symptoms may not indicate the section of the abdomen involved. Appendicitis may be diagnosed for acute intestinal obstruction. The history of the case is often a valuable guide. Occurring during the convalescence from typhoid fever, after pneumonia, or in a patient with previous cholecystitis, such a group of symptoms as mentioned would be highly suggestive. The differentiation of the variety of the cholecystitis can not be made. In the acute suppurative and phlegmonous forms the symptoms are usually more severe, perforation is very apt to occur, with local or general peritonitis, and unless operative measures are undertaken death ensues.

There is an acute cholecystitis, probably an infective form, in which the patient has recurring attacks of pain in the region of the gall-bladder. The diagnosis of gall-stones is made, but an operation shows simply an enlarged gall-bladder filled with mucus and bile, and the mucous membrane perhaps swollen and inflamed. In some of these cases gall-stones may have been present and have passed before the operation.

Treatment.—In the milder catarrhal forms the inflammation subsides spontaneously; in severer form operation is indicated and the results are ex-

Rosenow. J. A.M.A. - 1914. 63. 1835

... streptococci in many cases in walls of S.C.

... when contents were sterile.

Gastric symptoms in gallstones - Acidity - 80 cases

Urgent no stones subnormal no acidity - 437 - hyper. 39. normal 18.

Hill Mayo & Rosenow. Duct gallbladder.

Leucocytosis

Increase in the local signs, in leucocytosis and fever in
usually in diseases of the urinary. An enlarged & palpable
gall-bladder &c

Digestive lipaemia. Tech. Light supper without fat. Draw off blood in am.
Test Widal. + blood 2-5 hrs. later. Are blood swarms still fat droplets.
In total obstruction of bile passages - no absorption of fat into blood.
If jaundice from retention of bile pig. alone absorption not affected
but if retention of bile salts - fat particles do not appear.
Thus dissociation of bile + retention of only part of its elements could be det.
for retention of pigment or bile salts alone - liver must be responsible.
Tuberculosis of peritoneum absorption of fat -

cellent. Of 675 cholecystectomies at the Mayo clinic there were only seventeen deaths.

V. CANCER OF THE BILE-PASSAGES

Incidence.—Of 3,908 operations on the gall-bladder and biliary passages, in 85 or 2.1 per cent. cancer was found (Mayo). It is more common in women, 3 to 1 (Musser), and in three-fourths of the cases gall-stones are or have been present. The fundus of the bladder is usually attacked first.

Symptoms.—When the disease involves the *gall-bladder,* a tumor can be detected extending diagonally downward and inward toward the navel, variable in size, occasionally very large, due either to great distention of the gall-bladder or to involvement of contiguous parts. It is usually ~~very~~ firm and hard.

Among the important symptoms are jaundice, which was present in 69 per cent. of Musser's cases; pain, often of great severity and paroxysmal in character. The pain and tenderness on pressure persist in the intervals between the paroxysmal attacks. There is loss of weight, sometimes fever and sweats. When the liver becomes involved the picture is that of carcinoma of the organ.

Primary malignant disease in the *bile-ducts* is less common, and rarely forms tumors that can be felt externally. The tumor is usually in the common duct, 57 of 80 cases collected by Rolleston. There is usually an early, intense, and persistent jaundice. The gall-bladder is usually enlarged in obstruction of the common duct by malignant disease. The dilated gall-bladder may rupture. At best the diagnosis is very doubtful, unless cleared up by an exploratory operation. A very interesting form of malignant disease of the ducts is that which involves the diverticulum of Vater. Rolleston has collected 16 cases.

VI. STENOSIS AND OBSTRUCTION OF THE BILE-DUCTS

Stenosis.—Stenosis or complete occlusion may follow ulceration, most commonly after the passage of a gall-stone. In these instances the obstruction is usually situated low down in the common duct. Instances are extremely rare. Foreign bodies, such as the seeds of various fruits, may enter the duct, and occasionally round worms crawl into it. Liver-flukes and echinococci are rare causes of obstruction in man.

Obstruction.—Obstruction by *pressure* from without is more frequent. Cancer of the head of the pancreas, less often a chronic interstitial inflammation, may compress the terminal portion of the duct; rarely, cancer of the pylorus. Secondary involvement of the lymph-glands of the liver is a common cause of occlusion of the duct, and is met with in many cases of cancer of the stomach and other abdominal organs. Rare causes of obstruction are aneurism of a branch of the cœliac axis of the aorta, and pressure of very large abdominal tumors.

Symptoms.—The symptoms produced are those of chronic obstructive jaundice. At first, the liver is enlarged, but in chronic cases it may be reduced in size, and be found of a deeply bronzed color. The hepatic intermittent fever is not often associated with complete occlusion of the duct from

any cause, but it is most frequently met with in chronic obstruction by gall-stones. Permanent occlusion of the duct terminates in death. In a majority of the cases the conditions which lead to the obstruction are in themselves fatal. The liver, which is not necessarily enlarged, presents a moderate grade of cirrhosis. Cases of cicatricial occlusion may last for years.

Diagnosis.—A history of colic, jaundice of varying intensity, paroxysms of pain, and intermittent fever point to gall-stones. In cancerous obstruction the tumor mass can sometimes be felt in the epigastric region. In cases in which the lymph-glands in the transverse fissure are cancerous the primary disease may be in the pelvic organs or the rectum, or there may be a limited cancer of the stomach, which has not given any symptoms. In these cases the examination of the other lymphatic glands may be of value. Involvement of the clavicular groups of lymph-glands may also be serviceable in diagnosis. The gall-bladder is usually enlarged in obstruction of the common duct, except in the cases of gall-stones (Courvoisier's law). Great and progressive enlargement of the liver with jaundice and moderate continued fever is more commonly met with in cancer.

Congenital Obliteration of the Ducts.—John Thomson, in 1892, collected 49 cases and studied the condition thoroughly. C. P. Howard and Wolbach, reviewing the recent literature, bring the cases up to 76, exclusive of those associated with syphilis. Jaundice sets in early, but may be delayed for ten or twelve days, and is progressive and deep. Hæmorrhages in the skin, from the gastro-intestinal tract, and from the umbilical cord have occurred in fully 50 per cent. Nearly one-half of the cases die within the first month, a few live on for five or six months, but rarely as long as the tenth or twelfth.

Thomson regards congenital malformation as the chief cause, others are due to cholangitis and a few to congenital cirrhosis of the liver.

VI. CHOLELITHIASIS

No chapter in medicine is more interesting than that which deals with the question of gall-stones. Few affections present so many points for study—chemical, bacteriological, pathological, and clinical. The past few years have seen a great advance in our knowledge in two directions: First, as to the mode of formation of the stones, and, secondly, as to the surgical treatment of the cases.

Origin of Gall-stones.—Two important points with reference to the formation of calculi in the bile-passages were brought out by Naunyn: (*a*) The origin of the cholesterin of the bile, as well as of the lime salts from the mucous membrane of the biliary passages, particularly when inflamed; and (*b*) the remarkable association of micro-organisms with gall-stones. It is stated that Bristowe first noticed the origin of cholesterin in the gall-bladder itself, but Naunyn's observations showed that both the cholesterin and the lime were in great part a production of the mucosa of the gall-bladder and of the bile-ducts, particularly when in a condition of catarrhal inflammation excited by the presence of microbes. According to the views of this author, the lithogenous catarrh (which, by the way, is quite an old idea) modifies materially the chemical constitution of the bile and favors the deposition about epithelial

débris and bacteria of the insoluble salts of lime in combination with the bilirubin. Welch and others have demonstrated the presence of micro-organisms in the centre of gall-stones. Three additional points of interest may be referred to:

First, the demonstration that the gall-bladder is a peculiarly favorable habitat for micro-organisms. The colon bacilli, staphylococci, streptococci, pneumococci, and the typhoid bacilli have all been found here under varying conditions of the bile. A remarkable fact is the length of time that they may live in the gall-bladder, as was first demonstrated by Blachstein in Welch's laboratory. The typhoid bacillus has been isolated in pure culture 20 or 30 years after an attack.

Secondly, the experimental production of gall-stones has been successfully accomplished by Gilbert and Fournier by injecting micro-organisms into the gall-bladder of animals.

Thirdly, the association of gall-stones with the specific fevers. Bernheim, in 1889, first called attention to the frequency of gall-stone attacks after typhoid.

While it is probable that a lithogenous catarrh, induced by micro-organisms, is the most important single factor, there are other accessory causes of great moment.

Country.—Gall-stones are less frequent in the United States than in Germany, 6.94 to 12 per cent. (Mosher). They are less common in England than on the Continent.

Age.—Nearly 50 per cent. of all the cases occur in persons above forty years of age. They are rare under twenty-five. They have been met with in the new-born, and in infants (John Thomson).

Sex.—Three-fourths of the cases occur in women. Pregnancy has an important influence. Naunyn states that 90 per cent. of women with gall-stones have borne children.

All conditions which favor *stagnation of bile* in the gall-bladder predispose to the formation of stones. Among these may be mentioned corset-wearing, enteroptosis, nephroptosis, and occupations requiring a "leaning forward" position. Lack of exercise, sedentary occupations, particularly when combined with over-indulgence in food, constipation, and depressing mental emotions are also to be regarded as favoring circumstances. The belief prevailed formerly that there was a lithiac diathesis closely allied to that of gout.

Physical Characters of Gall-stones.—They may be single, in which case the stone is usually ovoid and may attain a very large size. Instances are on record of gall-stones measuring more than 5 inches in length. They may be extremely numerous, ranging from a score to several hundreds or even several thousands, in which case the stones are very small. When moderately numerous, they show signs of mutual pressure and have a polygonal form, with smooth facets; occasionally, however, five or six gall-stones of medium size are met with in the bladder which are round or ovoid and without facets. They are sometimes mulberry-shaped and very dark, consisting largely of bile-pigments. Again there are small, black calculi, rough and irregular in shape, and varying in size from grains of sand to small shot. These are sometimes known as gall-sand. On section, a calculus contains a nucleus, which consists of bile-pigment, rarely a foreign body. The greater portion of the stone is

made up of cholesterin, which may form the entire calculus and is arranged in concentric laminæ showing also radiating lines. Salts of lime and magnesia, bile acids, fatty acids, and traces of iron and copper are also found in them. Most gall-stones consist of from 70 to 80 per cent. of cholesterin, in either the amorphous or the crystalline form. As above stated, it is sometimes pure, but more commonly it is mixed with the bile-pigment. The outer layer of the stone is usually harder and brownish in color.

Seat of Formation.—Within the liver itself calculi are occasionally found, but are here usually small and not abundant, and in the form of ovoid, greenish-black grains. A large majority of all calculi are formed within the gall-bladder. The stones in the larger ducts have usually had their origin in the gall-bladder.

Symptoms.—In a number of cases gall-stones cause no symptoms. The gall-bladder will tolerate the presence of large numbers for an indefinite period of time, and post mortem examinations show that they are present in 25 per cent. of all women over sixty years of age (Naunyn). Moynihan claims that in most cases there are early symptoms—a sense of fullness, weight, and oppression in the epigastrium; a catch in the breath, a feeling of faintness or nausea, and a chilliness after eating. Attacks of indigestion are common, and it is important to remember that persistent gastric symptoms are often due to gall-stones. I have seen two cases with obstinate attacks of urticaria.

The main symptoms of cholelithiasis may be divided into (1) the aseptic, mechanical accidents in consequence of migration of the stone or of obstruction, either in the ducts or in the intestines; (2) the septic, infectious accidents, either local (the angiocholitis and cholecystitis with empyema of the gall-bladder, and the fistulæ and abscess of the liver and infection of the neighboring parts) or general, the biliary fever and the secondary visceral lesions.

Biliary Colic.—Gall-stones may become engaged in the cystic or the common duct without producing pain or severe symptoms. More commonly the passage of a stone excites the violent symptoms known as biliary colic. The attack sets in abruptly with agonizing pain in the right hypochondriac region, which radiates to the shoulder, or is very intense in the epigastric and in the lower thoracic regions. It is often associated with a rigor and a rise in temperature from 102° ~~degrees~~ to 103° ~~degrees~~. The pain is usually so intense that the patient rolls about in agony. There are vomiting, profuse sweating, and great depression of the circulation. There may be marked tenderness in the region of the liver, which may be enlarged, and the gall-bladder may become palpable and very tender. In other cases the fever is more marked. The spleen is enlarged (Naunyn) and the urine contains albumin with red blood-corpuscles. Ortner holds that *cholecystitis acuta*, occurring in connection with gall-stones, is a septic (bacterial) infection of the bile-passages. The symptoms of acute infectious cholecystitis and those of what we call gall-stone colic are very similar, and surgeons have frequently performed cholecystotomy for the former condition, believing calculi were present. In a large number of the cases jaundice occurs, but it is not a necessary symptom. Of course it does not happen during the passage of the stone through the cystic duct, but only when it becomes lodged in the common duct. The pain is due (*a*) to the slow progress in the cystic duct, in which the stone takes a rotary course owing to

the arrangement of the Heisterian valve; the cystic duct is poor in muscle fibres but rich in nerves and ganglia; (*b*) to the acute inflammation which usually accompanies an attack; (*c*) to the stretching and distention of the gall-bladder by retained secretions.

The attack varies in duration. It may last for a few hours, several days, or even a week or more. If the stone becomes impacted in the orifice of the common duct, the jaundice becomes intense; much more commonly it is a slight transient icterus. The attack of colic may be repeated at intervals for some time, but finally the stone passes and the symptoms disappear.

Occasionally accidents occur, such as rupture of the duct with fatal peritonitis. Fatal syncope during an attack and the occurrence of repeated convulsive seizures have come under my observation. These are, however, rare events. Palpitation and distress about the heart may be present, and occasionally a mitral murmur occurs during the paroxysm, but the cardiac conditions described by some writers as coming on acutely in biliary colic are possibly precëxistent in these patients.

The *diagnosis* of acute hepatic colic is generally easy. The pain is in the upper abdominal and thoracic regions, whereas the pain in nephritic colic is in the lower abdomen. A chill, with fever, is much more frequent in biliary colic than in gastralgia, with which it is liable, at times, to be confounded. A history of previous attacks is an important guide, and the occurrence of jaundice, however slight, determines the diagnosis. To look for the gall-stones, the stools should be thoroughly mixed with water and carefully filtered through a narrow-meshed sieve. Pseudo-biliary colic is not infrequently met with in nervous women, and the diagnosis of gall-stones made. This nervous hepatic colic may be periodical; the pain may be in the right side and radiating; sometimes associated with other nervous phenomena, often excited by emotion, fatigue or excesses. The liver may be tender, but there are neither icterus nor inflammatory conditions. The combination of colic and jaundice, so distinctive of gall-stones, is not always present. The pains may not be colicky, but more constant and dragging in character. A remarkable xanthoma of the bile-passages has been found in association with hepatic colic. Many patients with gall-stones have stomach symptoms—flatulency, regurgitation, and distress after eating. Sometimes the pain may be much increased by food or on exertion. In chronic gall-bladder cases, with adhesions and perforation, the clinical picture may resemble closely that of ulcer.

Obstruction of the Cystic Duct.—The effects may be thus enumerated:

(*a*) *Dilatation* of the gall-bladder—hydrops vesicæ felleæ. In acute obstruction the contents are bile mixed with much mucus or muco-purulent material. In chronic obstruction the bile is replaced by a clear fluid mucus. This is an important point in diagnosis, particularly as a dropsical gall-bladder may form a very large tumor. The reaction is not always constant. It is either alkaline or neutral; the consistence is thin and mucoid. Albumin is usually present. A dilated gall-bladder may reach an enormous size, and in one instance Tait found it occupying the greater part of the abdomen. In such cases, as is not unnatural, it has been mistaken for an ovarian tumor. I have described a case in which it was attached to the right broad ligament. The dilated gall-bladder can usually be felt below the edge of the liver, and in

many instances it has a characteristic outline like a gourd. An enlarged and relaxed organ may not be palpable, and in acute cases the distention may be upward toward the hilus of the liver. The dilated gall-bladder usually projects directly downward, rarely to one side or the other, though occasionally toward the middle line. It may reach below the navel, and in persons with thin walls the outline can be accurately defined. Riedel has called attention to a tongue-like projection of the anterior margin of the right lobe in connection with enlarged gall-bladder. It is to be remembered that distention of the gall-bladder may occur without jaundice; indeed, the greatest enlargement has been met with in such cases.

Gall-stone crepitus may be felt when the bladder is very full of stones and its walls not very tense. It is rarely well felt unless the abdominal walls are much relaxed. It may be found in patients who have never had any symptoms of cholelithiasis.

(*b*) *Acute cholecystitis.* The simple form is common, and to it are due probably very many of the symptoms of the gall-stone attack. Phlegmonous cholecystitis is rare. Perforation may occur with fatal peritonitis.

(*c*) *Suppurative cholecystitis,* empyema of the gall-bladder, is much more common, and in the great majority of cases is associated with gall-stones. There may be enormous dilatation, and over a litre of pus has been found. Perforation and the formation of abscesses in the neighborhood are not uncommon.

(*d*) *Calcification* of the gall-bladder is commonly a termination of the previous condition. There are two separate forms: incrustation of the mucosa with lime salts and the true infiltration of the wall with lime, the so-called ossification.

(*e*) *Atrophy* of the gall-bladder. This is by no means uncommon. The organ shrinks into a small fibroid mass, not larger, perhaps, than a good-sized pea or walnut, or even has the form of a narrow fibrous string; more commonly the gall-bladder tightly embraces a stone. This condition is usually preceded by hydrops of the bladder.

Occasionally the gall-bladder presents diverticula, which may be cut off from the main portion, and usually contain calculi.

Obstruction of the Common Duct.—There may be a single stone tightly wedged in the duct in any part of its course, or a series of stones, sometimes extending into both hepatic and cystic ducts, or a stone lies in the diverticulum of Vater. There are three groups of cases: (*a*) In rare instances a stone tightly corks the common duct, causing *permanent occlusion;* or it may partly rest in the cystic duct, and may have caused thickening of the junction of the ducts; or a big stone may compress the hepatic or upper part of the common duct. The jaundice is deep and enduring, and there are no septic features. The pains, the previous attacks of colic, and the absence of enlarged gall-bladder help to separate the condition from obstruction by new growths, although it cannot be differentiated with certainty. The ducts are usually much dilated and everywhere contain a clear mucoid fluid.

(*b*) *Incomplete obstruction, with infective cholangitis.* There may be a series of stones in the common duct, a single stone which is freely movable, or a stone (ball-valve stone) in the diverticulum of Vater. These conditions may be met with at autopsy, without the subjects having had symptoms point-

ing to gall-stones; but in a majority [illegible] there are very characteristic features.

The common duct may be as large as the thumb; the hepatic duct and its branches through the liver may be greatly dilated, and the distention may be even apparent beneath the liver capsule. Great enlargement of the gall-bladder is rarer. The mucous membrane of the ducts is usually smooth and clear, and the contents consist of a thin, slightly turbid bile-stained mucus.

Naunyn has given the following as the distinguishing signs of stone in the common duct: "(1) The continuous or occasional presence of bile in the fæces; (2) distinct variations in the intensity of the jaundice; (3) normal size or only slight enlargement of the liver; (4) absence of distention of the gall-bladder; (5) enlargement of the spleen; (6) absence of ascites; (7) presence of febrile disturbance; and (8) duration of the jaundice for more than a year."

In connection with the ball-valve stone, which is most commonly found in the diverticulum of Vater, though it may be in the common duct itself, there is a special symptom group: (*a*) Ague-like paroxysms, chills, fever, and sweating; the *hepatic intermittent fever* of Charcot; (*b*) jaundice of varying intensity, which persists for months or even years, and deepens after each paroxysm; (*c*) at the time of the paroxysm, pains in the region of the liver with gastric disturbance. These symptoms may continue on and off for three or four years, without the development of suppurative cholangitis. The condition has lasted from eight months to three years. The rigors are of intense severity, and the temperature rises to 103° or 105° F. The chills may recur daily for weeks, and present a tertian or quartan type, so that they are often attributed to malaria, with which, however, they have no connection. The jaundice is variable, and deepens after each paroxysm. The itching may be most intense. Pain, which is sometimes severe and colicky, does not always occur. There may be marked vomiting and nausea. As a rule there is no progressive deterioration of health. In the intervals between the attacks the temperature is normal.

The clinical history and the post mortem examinations show conclusively that this condition may persist for years without a trace of suppuration within the ducts. It is probable that the toxic symptoms develop only when a certain grade of tension is reached. An interesting and valuable diagnostic point is the absence of dilatation of the gall-bladder in cases of obstruction from stone—Courvoisier's rule.

(*c*) *Incomplete obstruction, with suppurative cholangitis.* When suppurative cholangitis exists the mucosa is thickened, often eroded or ulcerated; there may be extensive suppuration in the ducts throughout the liver, and even empyema of the gall-bladder. Occasionally the suppuration extends beyond the ducts, and there is localized liver abscess, or there is perforation of the gall-bladder with the formation of abscess between the liver and stomach.

Clinically it is characterized by a fever which may be intermittent, but more commonly is remittent and without prolonged intervals of apyrexia. The jaundice is rarely so intense, nor do we see the deepening of the color after the paroxysms. There is usually greater enlargement of the liver, and tenderness and more definite signs of septicæmia. The cases run a shorter course, and recovery never takes place.

The More Remote Effects of Gall-stones.—(*a*) *Biliary Fistulæ.*—(1) *Cutaneous.*—The external fistula is the most common, 184 out of 384 cases (Naunyn). A majority occur in the region of the navel, to which part the falciform ligament directs the suppuration. The number of stones discharged varies from one or two to many hundreds. Of the 184 cases in Courvoisier's statistics recovery took place in 78. In rare instances the fistula is in the right iliac fossa, or even in the thigh.

(2) *Gastro-intestinal Fistulæ.*—The duodenal is the most frequent, 108 of 384 cases (Naunyn). Usually the opening is between the fundus of the gall-bladder and the first part of the duodenum. A big stone may ulcerate through, leaving little or no damage. In other instances the cicatrization leads to obstruction. Communication with the ileum and jejunum is rare.

Fistulæ between the common duct and the duodenum occurred in 15 cases in Naunyn's series. Biliary gastric fistulæ are rare. The vomiting of gall-stones is not necessarily proof of the perforation, but in the majority of such cases the stones probably pass up through the pylorus.

(3) *Broncho-biliary Fistulæ.*—Of J. E. Graham's collected series of 35 cases, 19 were due to gall-stones; 11 to hydatids; 2 to round-worms; and in 2 the cause was doubtful. In a great many cases the amœbic abscess perforating into the lung is followed by a permanent biliary fistula.

(4) Perforation may occur into the *portal vein,* of which there are 3 or 4 cases on record, one of which, according to tradition, was the famous Ignatius Loyola.

(5) Perforation into the *hepatic artery* or one of its branches is exceedingly rare. Either an erosion from the common duct, or an hepatic aneurism may rupture into the gall-bladder.

(6) Fistula into the *urinary passages* may be with the pelvis of the kidney in which the gall-stone has been found, or into the urinary bladder, of which there are few cases on record.

(7) Lastly, the communication between the *pericardium* and the biliary tract is referred to by Naunyn in a single case.

(*b*) *Perforation into the Peritoneum.*—Of 119 cases (Courvoisier) in 70 the rupture occurred directly into the peritoneal cavity; in 49 an encapsulated abscess formed. As a rule, the condition is due to an acute cholecystitis.

(*c*) *Obstruction of the Bowel by Gall-stones.*—Reference has already been made to this; its frequency appears from the fact that of 295 cases of obstruction, occurring during eight years, analyzed by Fitz, 23 were by gall-stones. Courvoisier's statistics give a total number of 131 cases, in 6 of which the calculi had a peculiar situation, as in a diverticulum or in the appendix. Of the remaining 125 cases, in 70 the stone was spontaneously passed, usually with severe symptoms. The post mortem reports show that in some of these cases even very large stones have passed *per viam naturalem,* as the gall-duct has been enormously distended, its orifice admitting the finger freely. This, however, is extremely rare. The stones have been found most commonly in the ileum.

Treatment of Gall-stones and Their Effects.—General Treatment.—In an attack of biliary colic the patient should be kept under morphia, given hypodermically, in quarter-grain doses. In an agonizing paroxysm it is well

Fibrinolysis summary

to give a whiff or two of chloroform until the morphia has had time to act. Great relief is experienced from the hot bath and from fomentations in the region of the liver. The patient should be given laxatives and should drink copiously of alkaline mineral waters. Olive oil has proved useless in my hands. When taken in large quantities, fatty concretions are passed with the stools, which have been regarded as calculi; and concretions due to eating pears have been also mistaken, particularly when associated with colic attacks. Since the days of Durande, whose mixture of ether with turpentine is still largely used in France, various remedies have been advised to dissolve the stones within the gall-bladder, none of which are efficacious.

The diet should be regulated, the patient should take regular exercise and avoid, as much as possible, the starchy and saccharine foods. The soda salts recommended by Prout are believed to prevent the concentration of the bile and the formation of gall-stones. Either the sulphate or the phosphate may be taken in doses of from 1 to 2 drachms daily. For the intolerable itching McCall Anderson's dusting powder may be used: starch, an ounce; camphor, a drachm and a half; and oxide of zinc, half an ounce. Some of this should be finely dusted over the skin with a powder-puff. Powdering with starch, strong alkaline baths (hot), pilocarpin hypodermically (gr. ⅛–⅙, 0.008–0.01 gm.), and antipyrin (gr. v, 0.3 gm.), may be tried. Ichthyol and lanolin ointment sometimes gives relief.

Surgical Treatment.—The indications for operation are: (*a*) Repeated attacks of gall-stone colic. The patient is much safer in the hands of a surgeon than when left to Nature, with the feeble assistance of drugs and mineral waters. (*b*) The presence of a distended gall-bladder, associated with attacks of pain or with fever. (*c*) When a gall-stone is permanently lodged in the common duct, and the group of symptoms above described are present, the question, then, of advising operation depends largely upon the personal methods and success of the surgeon who is available.

Of 4,000 operations performed by the Mayo brothers to February 20th, 1911, the mortality was 2.57 per cent. Of 2,920 cases in which the gall-bladder alone was involved the mortality was 1.8 per cent. Of 492 cases in which the common duct was involved the mortality was 8 per cent. In 2.25 per cent. there was the complication of malignant disease.

The question comes up as to the re-formation of stones, but the possibility of this is very slight. In the Mayo series there were but 3 cases and it is probable that in the majority of instances the stones had not re-formed, but were incompletely removed.

VII. THE CIRRHOSES OF THE LIVER

General Considerations.—The many forms of cirrhoses of the liver have one feature in common—an increase in the connective tissue of the organ. In fact, we use the term cirrhosis (by which Laennec characterized the tawny, yellow color of the common atrophic form) to indicate similar changes in other organs.

Etiology.—There are five types of primary lesion, any one of which may lead to cirrhosis.

1. *Toxic Cirrhosis.*—This is the only acute type and it is seen post partum, in chloroform narcosis and sometimes as a terminal lesion in any form of disease. There is a central necrosis about the hepatic vein which may be slight in amount, or in some cases an acute yellow atrophy, very extensive so that the liver is rapidly reduced in size. Into the necrotic areas leucocytes migrate, the dead liver cells are quickly removed and there is an apparent increase of the connective tissue. Great regeneration of the liver cells is possible. Clinically this type can scarcely be spoken of as cirrhosis.

2. *Infectious Cirrhosis.*—Adami and his school hold that in many cases the colon bacilli from the bowel pass to the liver and there gradually excite a slow proliferation of connective tissue, regarding it as a kind of sub-infection. Mallory, whose classification I am following, thinks that the only type of true infectious cirrhosis is through the bile ducts, usually when there is bile stasis or gall-stones or other obstructions are present. Cases are described in which invasion occurs along apparently normal bile ducts and the organisms cause necrosis of the liver cells, proliferation of the fibroblasts, and thickening of the walls of the smaller bile ducts which may be dilated and tortuous.

Clinically this type is rare, and characterized by a chronic jaundice and enlargement of the liver.

3. *Pigment Cirrhosis.*—This may be an external pigment as in anthracosis in which the irritation of the coal particles reaching the liver through the lymphatics may excite a moderate grade of cirrhosis. The endogenous pigment is a transformation of hæmoglobin either as in malaria or as in the remarkable affection known as hæmochromatosis.

4. *Syphilitic Cirrhosis.*—Whether congenital or acquired, the essential lesion is produced by the *Treponema pallidum*, either a diffuse proliferation of fibroblasts, or a more localized lesion, the gumma.

5. *Alcoholic Cirrhosis.*—As a result of the toxic action of the alcohol, the liver cells, singly or in groups, undergo a slow necrosis, following which there is a multiplication of the fibroblasts with a hyalin degeneration of some cells and multiplication of others and an increase in the smaller bile ducts. Fatty infiltration is common, so that the organ may be enlarged.

Of these types the toxic and one form of the alcoholic are associated with shrinkage, the infectious, the pigmentary and the fatty cirrhosis with enlargement of the organ. Clinically we may consider four forms, the alcoholic, the hypertrophic (of Hanot), the syphilitic, and the capsular.

1. ALCOHOLIC CIRRHOSIS

Etiology.—The disease occurs most frequently in middle-aged males who have been addicted to drink. Whisky, gin, and brandy are more potent to cause cirrhosis than beer. It is more common in countries in which strong spirits are used than in those in which malt liquors are taken. Among 1,000 autopsies in my colleague Welch's department of the Johns Hopkins Hospital there were 63 cases of small atrophic liver, and 8 cases of the fatty cirrhotic organ. Lancereaux claims that the *vin ordinaire* of France is a common cause of cirrhosis. Of 210 cases, excess in wine alone was present in 68 cases.

Portail

Portail.

Contracts

He thinks it is the sulphate of potash in the plaster of Paris used to give the "dry" flavor which damages the liver.

Cirrhosis of the liver in young children is not very rare. In a certain number of the cases there is an alcoholic history, in others syphilis has been present, while a third group, due to the poisons of the infectious diseases, embraces a certain number of the cases of Hanot's hypertrophic cirrhosis.

Morbid Anatomy.—Practically on the post mortem table we see alcoholic cirrhosis in two well-characterized forms:

The Atrophic Cirrhosis of Laennec.—The organ is greatly reduced in size and may be deformed. The weight is sometimes not more than a pound or a pound and a half. It presents numerous granulations on the surface; is firm, hard, and cuts with great resistance. The substance is seen to be made up of greenish-yellow islands surrounded by grayish-white connective tissue. W. G. MacCallum has shown that regenerative changes in the cells are almost constantly present. This yellow appearance of the liver induced Laennec to give to the condition the name of cirrhosis.

The Fatty Cirrhotic Liver.—Even in the atrophic form the fat is increased, but in typical examples of this variety the organ is not reduced in size, but is enlarged, smooth or very slightly granular, anæmic, yellowish-white in color, and resembles an ordinary fatty liver. It is, however, firm, cuts with resistance, and microscopically shows a great increase in the connective tissue. This form occurs most frequently in beer-drinkers.

The two essential elements in cirrhosis are destruction of liver-cells and obstruction to the portal circulation.

In an autopsy on a case of atrophic cirrhosis the peritoneum is usually found to contain a large quantity of fluid, the membrane is opaque, and there is chronic catarrh of the stomach and of the small intestines. The spleen is enlarged, in part, at least, from the chronic congestion, possibly due in part to a toxic influence (Parkes Weber). The pancreas frequently shows interstitial changes. The kidneys are sometimes cirrhotic, the bases of the lungs may be much compressed by the ascitic fluid, the heart often shows marked degeneration, and arterio-sclerosis is usually present. A remarkable feature is the association of acute tuberculosis with cirrhosis. In seven cases of my series the patients died with either acute tuberculous peritonitis or acute tuberculous pleurisy. Rolleston has found that tuberculosis was present in 28 per cent. of 706 fatal cases of cirrhosis. Peritoneal tuberculosis was found in 9 per cent. of a series of 584 cases.

The compensatory circulation is usually readily demonstrated. It is carried out by the following set of vessels: (1) The accessory portal system of Sappey, of which important branches pass in the round and suspensory ligaments and unite with the epigastric and mammary systems. These vessels are numerous and small. Occasionally a large single vein, which may attain the size of the little finger, passes from the hilus of the liver, follows the round ligament, and joins the epigastric veins at the navel. Although this has the position of the umbilical vein, it is usually, as Sappey showed, a para-umbilical vein—that is, an enlarged vein by the side of the obliterated umbilical vessel. There may be produced about the navel a large bunch of varices, the so-called caput Medusæ. Other branches of this system occur in the gastro-epiploic omentum, about the gall-bladder, and, most important of all, in the

suspensory ligament. These latter form large branches, which anastomose freely with the diaphragmatic veins, and so unite with the vena axygos. (2) By the anastomosis between the œsophageal and gastric veins. The veins at the lower end of the œsophagus may be enormously enlarged, producing varices which project on the mucous membrane. (3) The communications between the hæmorrhoidal and the inferior mesenteric veins. The freedom of communication in this direction is very variable, and in some instances the hæmorrhoidal veins are not much enlarged. (4) The veins of Retzius, which unite the radicles of the portal branches in the intestines and mesentery with the inferior vena cava and its branches. To this system belong the whole group of retroperitoneal veins, which are in most instances enormously enlarged, particularly about the kidneys, and which serve to carry off a considerable proportion of the portal blood.

Symptoms.—The most extreme grade of atrophic cirrhosis may exist without symptoms. *So long as the compensatory circulation is maintained* the patient may suffer little or no inconvenience. The remarkable efficiency of this collateral circulation is well seen in those rare instances of permanent obliteration of the portal vein. The symptoms may be divided into two groups—obstructive and toxic.

Obstructive.—The overfilling of the blood-vessels of the stomach and intestine leads to chronic catarrh, and the patients suffer with nausea and vomiting, particularly in the morning; the tongue is furred and the bowels are irregular. Hæmorrhage from the stomach may be an early symptom; it is often profuse and liable to recur. It seldom proves fatal. The amount vomited may be remarkable as in a case already referred to, in which ten pounds were ejected in seven days. Following the hæmatemesis melæna is common; but hæmorrhages from the bowels may occur for several years without hæmatemesis. The bleeding very often comes from œsophageal varices. Very frequently epistaxis occurs. Enlargement of the spleen may, as Parkes Weber suggests, be due to a toxæmia. The organ can usually be felt. Evidences of the establishment of the collateral circulation are seen in the enlarged epigastric and mammary veins, more rarely in the presence of the caput Medusæ and in the development of hæmorrhoids. The distended venules in the lower thoracic zone along the line of attachment of the diaphragm are not specially marked in cirrhosis. The most striking feature of failure in the compensatory circulation is ascites, the effusion of serous fluid into the peritoneal cavity, which may appear suddenly. The conditions under which this occurs are still obscure. In some cases it is due more to chronic peritonitis than to the cirrhosis. The abdomen gradually distends, may reach a large size, and contain as much as 15 to 20 litres. Œdema of the feet may precede or develop with the ascites. The dropsy is rarely general.

Jaundice is usually slight, and was present in 107 of 293 cases of cirrhosis collected by Rolleston. The skin has frequently a sallow, slightly icteroid tint. The urine is often reduced in amount, contains urates in abundance, often a slight amount of albumin, and, if jaundice is intense, tube-casts. The disease may be afebrile throughout, but in many cases, as shown by Carrington, there is slight fever, from 100° to 102.5° F.

Examination at any early stage of the disease may show an enlarged and painful liver. In very many of the cases of alcoholic cirrhosis the organ is

"enlarged at all stages of the disease, and, whether enlarged or contracted, the clinical symptoms and course are much the same" (Foxwell). The patient may first come under observation for dyspepsia, hæmatemesis, slight jaundice, or nervous symptoms. Later in the disease the patient has an unmistakable hepatic facies; he is thin, the eyes are sunken, the conjunctivæ watery, the nose and cheeks show distended venules, and the complexion is muddy or icteroid. On the enlarged abdomen the vessels are distended, and a bunch of dilated veins may surround the navel. A venous hum, sometimes accompanied by a thrill, may be present in the epigastrium or over varicosities. Nævi of a remarkable character may appear on the skin, either localized stellate varices—spider angiomata—usually on the face, neck, and back, and also "mat" nævi, as I have called them—areas of skin of a reddish or purplish color due to the uniform distention of small venules. When much fluid is in the peritoneum it is impossible to make a satisfactory examination, but after withdrawal the area of liver dulness is found to be diminished, particularly in the middle line, and on deep pressure the edge of the liver can be detected, and occasionally the hard, firm, and even granular surface. The spleen can be felt in the left hypochondriac region. Examination of the anus may reveal the presence of hæmorrhoids.

Toxic Symptoms.—At any stage of atrophic cirrhosis the patient may have cerebral symptoms, either a noisy, joyous delirium, or stupor, coma, or even convulsions. The condition is not infrequently mistaken for uræmia. The nature of the toxic agent is not yet settled. Without jaundice, and not attributable to cholæmia, the symptoms may come on in hospital when the patient has not had alcohol for weeks.

The fatty cirrhotic liver may produce symptoms similar to those of the atrophic form, but more frequently it is latent and is found accidentally in topers who have died from various diseases. The greater number of the cases clinically diagnosed as cirrhosis with enlargement come in this division.

Diagnosis.—With ascites, a well-marked history of alcoholism, the hepatic facies, and hæmorrhage from the stomach or bowels, the diagnosis is rarely doubtful. If, after withdrawal of the fluid, the spleen is found to be enlarged and the liver either not palpable or, if it is enlarged, hard and regular, the probabilities in favor of cirrhosis are very great. In the early stages of the disease, when the liver is increased in size, it may be impossible to say whether it is a cirrhotic or a fatty liver. The differential diagnosis between common and syphilitic cirrhosis can sometimes be made. A marked history of syphilis or the existence of other syphilitic lesions, with great irregularity in the surface or at the edge of the liver, are the points in favor of the latter. Thrombosis or obliteration of the portal vein can rarely be differentiated. In a case of fibroid transformation of the portal vein which came under my observation, the collateral circulation had been established for years, and the symptoms were simply those of extreme portal obstruction, such as occur in cirrhosis. Thrombosis of the portal vein may occur in cirrhosis and be characterized by a rapidly developing ascites.

Prognosis.—The outlook is bad. When the collateral circulation is fully established the patient may have no symptoms whatever. There are instances of enlargement of the liver, slight jaundice, cerebral symptoms, and even hæmatemesis, in which the liver becomes reduced in size, the symptoms disap-

pear, and the patient may live in comparative comfort for many years. There are cases, too, possibly syphilitic, in which, after one or two tappings, the symptoms have disappeared and the patients have apparently recovered. Ascites is a very serious event, especially if due to the cirrhosis and not to an associated peritonitis. Of 34 cases with ascites 10 died before tapping was necessary; 14 were tapped, and the average duration of life after the swelling was first noticed was only eight weeks; of 10 cases the diagnosis was wrong in 4, and in the remaining 6, who were tapped oftener than once, chronic peritonitis and perihepatitis were present (Hale White).

2. HYPERTROPHIC CIRRHOSIS (*Hanot*)

This well-characterized form was first described by Requin in 1846, but our accurate knowledge of the condition dates from the work of Hanot (1875), whose name in France it bears—*maladie de Hanot.*

Cirrhosis with enlargement occurs in the early stage of atrophic cirrhosis; there is an enlarged fatty and cirrhotic liver of alcoholics, a pigmentary form occurs in hæmochromatosis, and in association with syphilis the organ is often very large. The hypertrophic cirrhosis of Hanot is easily distinguished from these forms.

Etiology.—Males are more often affected than females—in 22 of Schachmann's 26 cases. The subjects are young; some of the cases in children probably belong to this form. Alcohol plays a minor part, and not one of my patients had been a heavy drinker. The absence of all known etiological factors is a remarkable feature.

Morbid Anatomy.—The organ is enlarged, weighing from 2,000 to 4,000 grams. The form is maintained, the surface is smooth, or presents small granulations; the color in advanced cases is of a dark olive green; the consistence is greatly increased. The section is uniform, greenish yellow in color, and the liver nodules may be seen separated by connective tissue. The bile-passages present nothing abnormal. The cirrhosis is mono- or multilobular, with a connective tissue rich in round cells. The bile-vessels are the seat of an angiocholitis, catarrhal and productive, and there is an extraordinary development of new biliary canaliculi. The liver-cells are neither fatty nor pigmented, and may be increased in size and show karyokinetic figures. From the supposed origin about the bile-vessels it has been called biliary cirrhosis, but the histological details have not yet been worked out fully, and the separation of this as a distinct form should, for the present at least, rest upon clinical rather than anatomical grounds. The spleen is greatly enlarged and may weigh 600 or more grams.

Symptoms.—As previously stated, the cases occur in young persons; there is not, as a rule, an alcoholic history, and males are usually affected. The features are: (*a*) A remarkably chronic course of from four to six, or even ten years. (*b*) Jaundice, usually slight, often not more than a lemon tint, or a tinging of the conjunctivæ. At any time during the course an *icterus gravis*, with high fever and delirium, may develop. There is bile in the urine; the stools are not clay-colored as in obstructive jaundice, but may be very dark and "bilious." (*c*) Attacks of pain in the region of the liver, which may be severe and associated with nausea and vomiting. The pain may be

Bribery!

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slight and dragging, and in some cases is not at all a prominent symptom. The jaundice may deepen after attacks of pain. (*d*) Enlarged liver. A fullness in the upper abdominal zone may be the first complaint. On inspection the enlargement may be very marked. In one of my cases the left lobe was unusually prominent and stood out almost like a tumor. An exploratory operation showed only an enlarged, smooth organ without adhesions. On palpation the hypertrophy is uniform, the consistence is increased, and the edge distinct and hard. The gall-bladder is not enlarged. The vertical flatness is much increased and may extend from the sixth rib to the level of the navel. (*e*) The spleen is enlarged, easily palpable, and very hard. (*f*) Certain negative features are of moment—the usual absence of ascites and of dilatation of the subcutaneous veins of the abdomen. Among other symptoms may be mentioned hæmorrhages. One of my patients had bleeding at the gums for a year; another had had for years most remarkable attacks of purpura with urticaria. Pruritus, xanthoma, lichen, and telangiectasis may be present in the skin. In one of my patients the skin became very bronzed, almost as deeply as in Addison's disease. Slight fever may be present, which increases during the crises of pain. There may be a marked leucocytosis. A curious attitude of the body has been seen, in which the right shoulder and right side appear dragged down. The patients die with the symptoms of icterus gravis, from hæmorrhage, from an intercurrent infection, or in a profound cachexia. Certain of the cases of cirrhosis of the liver in children are of this type; the enlargement of the spleen may be very pronounced.

3. SYPHILITIC CIRRHOSIS

This is considered in the section on syphilis (p. 273). I refer to it again to emphasize (1) its frequency; (2) the great importance of its differentiation from the alcoholic form; (3) its curability in many cases; and (4) the tumor formations in connection with it.

4. CAPSULAR CIRRHOSIS—PERIHEPATITIS

Local capsulitis is common in many conditions of the liver. The form of disease here described is characterized by an enormous thickening of the entire capsule, with great contraction of the liver, but not necessarily with special increase in the connective tissue of the organ itself. Our chief knowledge of the disease we owe to the Guy's Hospital physicians, particularly to Hilton Fagge and to Hale White, who collected 22 cases from the records. The liver substance itself was "never markedly cirrhotic; its tissue was nearly always soft." Chronic capsulitis of the spleen and a chronic proliferative peritonitis are almost invariably present. In 19 of the 22 cases the kidneys were granular. Hale White regards it as a sequel of interstitial nephritis. The youngest case in his series was twenty-nine. The symptoms are those of atrophic cirrhosis—ascites, often recurring and requiring many tappings. Jaundice is not often present. I have met with two groups of cases—the one in adults usually with ascites and regarded as ordinary cirrhosis. I have never made a diagnosis in such a case. Signs of interstitial nephritis, recurring ascites, and absence of jaundice are regarded by Hale White as important

diagnostic points. In the second group of cases the perihepatitis, perisplenitis, and proliferative peritonitis are associated with adherent pericardium and chronic mediastinitis. In one such case the diagnosis of capsular hepatitis was very clear, as the liver could be grasped in the hand and formed a rounded, smooth organ resembling the spleen. The child was tapped 121 times (Archives of Pædiatrics, 1896).

TREATMENT OF THE CIRRHOSES

The portal function of the liver may be put out of action without much damage to the body. There may be an extreme grade of cirrhotic atrophy without symptoms; the portal vein may be obliterated, or, experimentally, the portal vein may be anastomosed with the cava. So long as there is an active compensatory circulation a patient with ~~atrophic~~ cirrhosis may remain well. In the hypertrophic form toxæmia is the special danger. ~~In the hypertrophic cirrhosis~~ we have no means of arresting the progress of the disease. In the alcoholic form it is too late, as a rule, to do much after symptoms have occurred. In a few cases an attack of jaundice or hæmatemesis may prove the salvation of the patient, who may afterward take to a temperate life. The diet should be very simple and large amounts of water taken to aid elimination. The bowels should be kept open, for which the use of the salines is generally best. An occasional course of potassium iodide may be given. With the advent of ascites the critical stage is reached. Restriction of fluid intake and free purgation may relieve a small exudate, rarely a large one, and it is best to tap early, or to advise Talma's operation. In the syphilitic cirrhosis much more can be done, and a majority of the cases of cure after ascites are of this variety.. Iodide of potassium in moderate doses, 15 to 30 drops of the saturated solution, and the Addison pill save a number of cases even after repeated tapping. The diagnosis may be reached only after removal of the fluid, but in every case with a history of syphilis, a positive Wassermann reaction, or with irregularity of the liver this treatment should be tried.

Surgical Treatment.—(*a*) *Tapping.*—When the ascites increases it is better to tap early. As Hale White remarks, a case of cirrhosis of the liver which is tapped rarely recovers, but there are instances in which early and repeated paracentesis is followed by cure. Accidents are rare; hæmorrhage, acute peritonitis, or erysipelas at the point of puncture occasionally follow; collapse may occur during the operation, to guard against which Mead advised the use of the abdominal binder. Continuous drainage with Southey's tubes is not often practicable and has no special advantages. (*b*) *Laparotomy*, with complete removal of the fluid, and freshening or rubbing the peritoneal surfaces, to stimulate the formation of adhesions. (*c*) *Omentopexy*, the stitching of the omentum to the abdominal wall, and the establishment of collateral circulation in this way between the portal and the systemic vessels. This operation is sometimes ~~very~~ successful, ~~and may be recommended~~. In 224 cases there were 84 deaths and 129 recoveries; 11 cases doubtful. Among the 129 successful cases, in 25 the ascites recurred; 70 appeared to have completely recovered. (*d*) *Fistula of Eck.* The porto-caval anastomosis has been performed once in man in cirrhosis of the liver (Widal, *La Semaine Médicale*, 1903). The patient lived for three months.

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VIII. ABSCESS OF THE LIVER

Etiology.—Suppuration within the liver, either in the parenchyma or in the blood or bile passages, occurs under the following conditions:

(*a*) The *tropical abscess,* also called the *solitary,* commonly follows amœbic dysentery. It frequently occurs among Europeans in India, particularly those who drink alcohol freely and are exposed to great heat. Cases may occur without a history of previous dysentery, and there have been fatal cases without any affection of the large bowel. In the United States the large solitary abscess is not very infrequent. The relation of this form of abscess to the *Amœba dysenteriæ* has been considered.

(*b*) *Traumatism* is an occasional cause. The injury is generally in the hepatic region. Two instances of it have come under my notice in trainmen who were injured while coupling cars. Injury to the head is not infrequently followed by liver abscess.

(*c*) *Embolic* or *pyæmic abscesses* are the most numerous, occurring in a general pyæmia or following foci of suppuration in the territory of the portal vessels. The infective agents may reach the liver through the hepatic artery, as in those cases in which the original focus of infection is in the area of the systemic circulation; though it may happen occasionally that the infective agent, instead of passing through the lungs, reaches the liver through the inferior vena cava and the hepatic veins. A remarkable instance of multiple abscesses of arterial origin was afforded by the case of aneurism of the hepatic artery reported by Ross and myself. Infection through the portal vein is much more common. It results from dysentery and other ulcerative affections of the bowels, appendicitis, occasionally after typhoid fever, in rectal affections, and in abscesses in the pelvis. In these cases the abscesses are multiple and, as a rule, within the branches of the portal vein—suppurative pylephlebitis.

(*d*) A not uncommon cause of suppuration is *inflammation of the bile-passages* caused by gall-stones, more rarely by parasites—suppurative cholangitis.

In some instances of tuberculosis of the liver the affection is chiefly of the bile-ducts, with the formation of multiple tuberculous abscesses containing a bile-stained pus

(*e*) *Foreign bodies and parasites.* In rare instances foreign bodies, such as a needle, may pass from the stomach or gullet, lodge in the liver, and excite an abscess, or, as in several instances which have been reported, a foreign body, such as a needle or a fish-bone, has perforated a branch or the portal vein itself and induced pylephlebitis. Echinococcus cysts frequently cause suppuration, the penetration of round worms into the liver less commonly, and most rarely of all the liver-fluke.

Morbid Anatomy.—(*a*) Of the Solitary or Tropical Abscess.—This has been described under amœbic dysentery.

(*b*) Of Septic and Pyæmic Abscesses.—These are usually multiple, though occasionally, following injury, there may be a large solitary collection of pus.

In suppurative pylephlebitis the liver is uniformly enlarged. The cap-

sule may be smooth and the external surface of the organ of normal appearance. In other instances, numerous yellowish-white points appear beneath the capsule. On section there are isolated pockets of pus, either having a round outline or in some places distinctly dendritic, and from these the pus may be squeezed. They look like small, solitary abscesses, but, on probing, are found to communicate with the portal vein and to represent its branches, distended and suppurating. The entire portal system within the liver may be involved; sometimes territories are cut off by thrombi. The suppuration may extend into the main branch or even into the mesenteric and gastric veins. The pus may be fetid and is often bile-stained; it may, however, be thick and tenacious. In suppurative cholangitis there is usually obstruction by gall-stones, the ducts are greatly distended, the gall-bladder enlarged and full of pus, and the branches within the liver are extremely distended, so that on section there is an appearance not unlike that described in pylephlebitis. An abscess may have a sponge-like appearance due to the fusion of numerous points of suppuration.

Suppuration about the echinococcus cysts may be very extensive, forming enormous abscesses, the characters of which are at once recognized by the remnants of the cysts.

Symptoms.—(*a*) Of the Large Solitary Abscess.—The abscess may be latent and run a course without definite symptoms; death may occur suddenly from rupture.

Fever, pain, enlargement of the liver, and a septic condition are the important symptoms of hepatic abscess. The temperature is elevated at the outset and is of an intermittent or septic type. It is irregular, and may remain normal or even subnormal for a few days; then the patient has a rigor and the temperature rises to 103° F. or higher. Owing to this intermittent character of the fever the disease is often mistaken for malaria. The fever may rise every afternoon without a rigor. Profuse sweating is common, particularly when the patient falls asleep. In chronic cases there may be little or no fever. One of my patients, with a liver abscess which had perforated the lung, coughed up pus after his temperature had been normal for weeks. The pain is variable, and is usually referred to the back or shoulder; or there is a dull aching sensation in the right hypochondrium. When turned on the left side, the patient often complains of a heavy, dragging sensation, so that he usually prefers to lie on the right side; at least, this has been the case in a majority of the instances which have come under my observation. Pain on pressure over the liver is usually present, particularly on deep pressure at the costal margin in the nipple line.

The enlargement of the liver is most marked in the right lobe, and, as the abscess cavity is usually situated more toward the upper than the under surface, the increase in volume is upward and to the right, not downward, as in cancer and the other affections producing enlargement. Percussion in the mid-sternal and parasternal lines may show a normal limit. At the nipple-line the curve of liver dulness begins to rise, and in the mid-axillary it may reach the fifth rib, while behind, near the spine, the area of dulness may be almost on a level with the angle of the scapula. Of course there are instances in which this characteristic feature is not present, as when the abscess occupies the left lobe. The enlargement of the liver may be so great as to cause

bulging of the right side, and the edge may project a hand's-breadth or more below the costal margin. In such instances the surface is smooth. Palpation is painful, and there may be fremitus on deep inspiration. In some instances fluctuation may be detected. Adhesions may form to the abdominal wall and the abscess may point below the margin of the ribs, or even in the epigastric region. In many cases the appearance of the patient is suggestive. The skin has a sallow, slightly icteroid tint, the face is pale, the complexion muddy, the conjunctivæ are infiltrated, and often slightly bile-tinged. There is in the facies and in the general appearance of the patient a strong suggestion of the existence of abscess. There is no internal affection associated with suppuration which gives, I think, just the same hue as certain instances of abscess of the liver. Marked jaundice is rare. Diarrhœa may be present and may give an important clew to the nature of the case, particularly if amœbæ are found in the stools. Constipation may occur.

Perforation of the lung occurred in 9 of the 27 cases in my series. The symptoms are most characteristic. The extension may occur through the diaphragm, without actual rupture, and with the production of a purulent pleurisy and invasion of the lung. With cough of an aggravated and convulsive character, there are signs of involvement at the base of the right lung, defective resonance, feeble tubular breathing, and increase in the tactile fremitus; but the most characteristic feature is the presence of a reddish-brown expectoration of a brick-dust color, resembling anchovy sauce. This, which was noted originally by Budd, was present in our cases, and ~~in addition~~ Reese and Lafleur found ~~the~~ *amœbæ* ~~not~~ identical with those which exist in the liver abscess and in the stools. They are present in variable numbers and display active amœboid movements. The brownish tint of the expectoration is due to blood-pigment and blood-corpuscles, and there may be orange-red crystals of hæmatoidin.

The abscess may perforate externally, as mentioned already, or into the stomach or bowel; occasionally into the pericardium. The duration of this form is very variable. It may run its course and prove fatal in six or eight weeks or may persist for several years.

The prognosis is serious, as the mortality is more than 50 per cent. The death-rate has been lowered of late years, owing to the great fearlessness with which the surgeons now attack these cases.

(*b*) Of the Pyæmic Abscess and Suppurative Pylephlebitis.—Clinically these conditions cannot be separated. Occurring in a general pyæmia, no special features may be added to the case. When there is suppuration within the portal vein the liver is uniformly enlarged and tender, though pain may not be a marked feature. There is an irregular, septic fever, and the complexion is muddy, sometimes distinctly icteroid. The features are indeed those of pyæmia, plus a slight icteroid tinge, and an enlarged and painful liver. The latter features alone are peculiar. The sweats, chills, prostration, and fever have nothing distinctive.

Diagnosis.—Abscess of the liver may be confounded with intermittent fever, a common mistake in malarial regions. Practically an intermittent fever which resists quinine is not malarial. Laveran's organisms are also absent from the blood. When the abscess bursts into the pleura a right-sided empyema is produced and perforation of the lung usually follows. When

the liver abscess has been latent and dysenteric symptoms have not been marked, the condition may be considered empyema or abscess of the lung. In such cases the anchovy-sauce-like color of the pus and the presence of the amœbæ will enable one to make a definite diagnosis. Perforation externally is readily recognized, and yet in an abscess cavity in the epigastric region it may be difficult to say whether it has proceeded from the liver or is in the abdominal wall. When the abscess is large, and the adhesions are so firm that the liver does not descend during inspiration, the exploratory needle does not make an up-and-down movement during aspiration. The diagnosis of suppurating echinococcus cyst is rarely possible, except in Australia and Iceland, where hydatids are so common.

Perhaps the most important affection from which suppuration within the liver is to be separated is the intermittent hepatic fever associated with gallstones. Of the cases reported a majority have been considered due to suppuration, and in two of my cases the liver had been repeatedly aspirated. Post mortem examinations have shown conclusively that the high fever and chills may recur at intervals for years without suppuration in the ducts. The distinctive features of this condition are paroxysms of fever with rigors and sweats—which may occur with great regularity, but which more often are separated by long intervals—the deepening of the jaundice after the paroxysms, the entire apyrexia in the intervals, and the maintenance of the general nutrition. The time element also is important, as in some of these cases the disease has lasted for several years. Finally, it is to be remembered that abscess of the liver, in temperate climates at least, is invariably secondary, and the primary source must be carefully sought for, either in dysentery, slight ulceration of the rectum, suppurating hæmorrhoids, ulcer of the stomach, or in suppurative disease of other parts of the body, particularly within the skull or in the bones.

Leucocytosis may be absent in the amœbic abscess of the liver; in septic cases it may be very high.

In suspected cases, whether the liver is enlarged or not, exploratory aspiration may be performed. The needle may be entered in the anterior axillary line in the lowest interspace, or in the seventh interspace in the mid-axillary line, or over the centre of the area of dulness behind. The patient should be placed under ether, for it may be necessary to make several deep punctures. It is not well to use too small an aspirator. No ill effects follow this procedure, even though blood may leak into the peritoneal cavity. Extensive suppuration may exist, and yet be missed in the aspiration, particularly when the branches of the portal vein are distended with pus.

Treatment.—Pyæmic abscess and suppurative pylephlebitis are invariably fatal. Treves, however, reports a case of pyæmic abscess following appendicitis in which the patient recovered after an exploratory operation. Surgical measures are not justified in these cases, unless an abscess shows signs of pointing. As the abscesses associated with dysentery are often single, they afford a reasonable hope of benefit from operation. If, however, the patient is expectorating the pus, if the general condition is good and the hectic fever not marked, it is best to defer operation, as many of these instances recover spontaneously. The large single abscesses are the

most favorable for operation. The general medical treatment of the cases is that of ordinary septicæmia.

IX. NEW GROWTHS IN THE LIVER

These may be cancer, either primary or secondary, sarcoma, or angioma.

Etiology.—Cancer of the liver is third in order of frequency of internal cancer. It is rarely primary, usually secondary to cancer in other organs. It is a disease of late adult life. According to Leichtenstern, over 50 per cent. of the cases occur between the fortieth and the sixtieth years. It occasionally occurs in children. Women are attacked less frequently than men. It is stated by some authors that secondary cancer is more common in women, owing to the frequency of cancer of the uterus. Heredity is believed to have an influence in from 15 to 20 per cent.

In many cases trauma is an antecedent, and cancer of the bile-passages is associated in many instances with gall-stones. Cancer is stated to be less common in the tropics.

Morbid Anatomy.—The following forms of new growths occur in the liver and have a clinical importance:

Cancer.—*Primary Cancer.*—This is rare. Of 163 cases collected by Eggel, 63.3 per cent. were in males. There are several varieties. Nodular forms, in which there are scattered growths throughout the organ; the massive form in which the solitary tumor occupies a large area, either a lobe or the greater part of it; and small metastatic nodules. A very important form is that in which the liver is diffusely infiltrated with small growths, with much hyperplasia of the connective tissue—the so-called cancer with cirrhosis. The course of the disease is rapid, jaundice often occurs, splenic enlargement is not infrequent, ascites and œdema are common and toxic features are frequent toward the close.

Secondary Cancer.—The organ may reach an enormous size, 30½ pounds (Osler), 33 pounds (Christian). The cancerous nodules project beneath the capsule, and can be felt during life or even seen through the thin abdominal walls. They are usually disseminated equally, though in rare instances they may be confined to one lobe. The consistence of the nodules varies; in some cases they are firm and hard and those on the surface show a distinct umbilication, due to the shrinking of the fibrous tissue in the centre. These superficial cancerous masses are still sometimes spoken of as "Farre's tubercles." More frequently the masses are on section grayish-white in color, or hæmorrhagic. Rupture of blood-vessels is not uncommon in these cases. In one specimen there was an enormous clot beneath the capsule of the liver, together with hæmorrhage into the gall-bladder and into the peritoneum. The secondary cancer shows the same structure as the initial lesion, and is usually either an alveolar or cylindrical carcinoma. Degeneration is common, in these secondary growths; thus the hyaline transformation may convert large areas into a dense, dry, grayish-yellow mass. Extensive areas of fatty degeneration may occur, sclerosis is not uncommon, and hæmorrhages are frequent. Suppuration sometimes follows.

Cancer of the bile-passages which has been already considered.

Sarcoma.—Of primary sarcoma of the liver very few cases have been reported. Secondary sarcoma is more frequent, and many examples of lympho-sarcoma and myxo-sarcoma are on record, less frequently glio-sarcoma or the smooth or striped myoma.

The most important form is the melano-sarcoma, secondary to sarcoma of the eye or of the skin. Very rarely melano-sarcoma occurs primarily in the liver. In this form the liver is greatly enlarged, is either uniformly infiltrated with the growth, which gives the cut surface the appearance of dark granite, or there are large nodular masses of a deep black or marbled color. There are usually extensive metastases, and in some instances every organ of the body is involved. Nodules of melano-sarcoma of the skin may give a clew to the diagnosis.

Other Forms of Liver Tumor.—One of the commonest tumors in the liver is the angioma, which occurs as a small, reddish body the size of a walnut, and consists simply of a series of dilated vessels. Occasionally in children angiomata grow and produce large tumors.

Cysts are occasionally found, in the liver, either single, which is not very uncommon, or multiple, when they usually coexist with congenital cystic kidneys.

Symptoms.—It is often impossible to differentiate primary and secondary cancer of the liver unless the primary seat of the disease is evident, as in the case of scirrhus of the breast, or cancer of the rectum, or of a tumor in the stomach, which can be felt. As a rule, cancer of the liver is associated with progressive enlargement; but in some cases of primary nodular cancer and in the cancer with cirrhosis the organ may not be enlarged. Gastric disturbance, loss of appetite, nausea, and vomiting are frequent. Progressive loss of flesh and strength may be the first symptoms. Pain or a sensation of uneasiness in the right hypochondriac region may be present, but enormous enlargement of the liver may occur without the slightest pain. Jaundice, which is present in at least half of the cases, is usually of moderate extent, unless the common duct is occluded. Ascites is rare, except in the form of cancer with cirrhosis, in which the clinical picture is that of the atrophic form. Pressure by nodules on the portal vein or extension of the cancer to the peritoneum may also induce ascites.

Inspection shows the abdomen to be distended, particularly in the upper zone. In late stages of the disease, when emaciation is marked, the cancerous nodules can be plainly seen beneath the skin, and in rare instances even the umbilications. The superficial veins are enlarged. On palpation the liver is felt, a hand's-breadth or more below the costal margin, descending with each inspiration. The surface is usually irregular, and may present large masses or smaller nodular bodies, either rounded or with central depressions. In instances of diffuse infiltration the liver may be greatly enlarged and present a perfectly smooth surface. The growth is progressive, and the edge of the liver may ultimately extend below the level of the navel. Although generally uniform and producing enlargement of the whole organ, occasionally the tumor in the left lobe forms a solid mass occupying the epigastric region. By percussion the outline can be accurately limited and the progressive growth of the tumor estimated. The spleen is rarely enlarged. Pyrexia is present in many cases, usually a continuous fever, ranging from 100° to 102° F.; it may

be intermittent, with rigors. This may be associated with the cancer alone, or, as in one of my cases, with suppuration. Œdema of the feet, from anæmia, usually supervenes. Cancer of the liver kills in from three to fifteen months. One of my patients lived for more than two years.

Diagnosis.—The diagnosis is easy when the liver is greatly enlarged and the surface nodular. The smoother forms of diffuse carcinoma may at first be mistaken for fatty or amyloid liver, but the presence of jaundice, the rapid enlargement, and the more marked cachexia will usually suffice to differentiate it. Perhaps the most puzzling conditions occur in the rare cases of enlarged amyloid liver with irregular gummata. The large echinococcus liver may present a striking similarity to carcinoma, but the projecting nodules are usually softer, the disease lasts much longer, and the cachexia is not marked.

Hypertrophic cirrhosis may at first be mistaken for carcinoma, as the jaundice is usually deep and the liver very large; but the absence of a marked cachexia and wasting and the painless, smooth character of the enlargement are points against cancer. In large, rapidly growing secondary cancers the superficial rounded masses may almost fluctuate and these soft tumor-like projections may contain blood. The form of cancer with cirrhosis can scarcely be separated from atrophic cirrhosis itself. Perhaps the wasting is more extreme and more rapid, but the jaundice and the ascites are identical. Melano-sarcoma causes great enlargement of the organ. There are frequently symptoms of involvement of other viscera, as the lungs, kidneys, or spleen. Secondary tumors may occur in the skin. A very important symptom, not present in all cases, is melanuria, the passage of a very dark-colored urine, which may, however, when first voided, be quite normal in color. The existence of a melano-sarcoma of the eye, or the history of blindness in one eye, with subsequent extirpation, may indicate at once the true nature of the hepatic enlargement.

There are several conditions in which the liver itself, or portions of it, may be mistaken for tumor. (*a*) In a progressive cirrhosis with enlargement the left lobe may increase out of all proportion to the right, and form a prominent mass in the epigastrium. (*b*) Riedel's tongue-like lobe projecting from the edge in the neighborhood of the gall-bladder, and often associated with distention of this organ. (*c*) The extreme left portion of the organ may be almost separated by a broad, flat band, containing little or no liver tissue. In a very thin person this section may feel like a separate tumor mass, as in an instance reported by J. P. Inglis (Polyclinic, Jan., 1911). A small portion of the liver lay directly over the cœliac axis, connected with the left lobe by a mesentery. The tumor was palpable. Lastly, the contracted, deformed organ in perihepatitis may form a visible, freely movable tumor in the upper portion of the abdomen, without a semblance of the normal liver. Such an instance I figure in my lectures on *Abdominal Tumors*.

Treatment.—The treatment must be entirely symptomatic. The question of surgical interference may be discussed. Keen has collected reports of 76 cases of resection of tumors of the liver, 63 of which recovered.

X. FATTY LIVER

Two different forms of this condition are recognized—the fatty infiltration and fatty degeneration.

Fatty infiltration occurs, to a certain extent, in normal livers, since the cells always contain minute globules of oil.

In fatty degeneration, which is much less common, the protoplasm of the liver-cells is destroyed and the fat takes its place, as seen in cases of malignant jaundice and phosphorus poisoning.

Fatty liver occurs under the following conditions: (*a*) In association with general obesity, in which case the liver appears to be one of the storehouses of the excessive fat. (*b*) In conditions in which the oxidation processes are interfered with, as in cachexia, profound anæmia, and in phthisis. The fatty infiltration of the liver in heavy drinkers is to be attributed to the excessive demand made by the alcohol upon the oxygen. (*c*) Certain poisons, of which phosphorus is the most characteristic, produce an intense fatty degeneration with necrosis of the liver-cells. The poison of acute yellow atrophy, whatever its nature, acts in the same way.

The fatty liver is uniformly increased in size. The edge may reach below the level of the navel. It is smooth, looks pale and bloodless; on section it is dry, and renders the surface of the knife greasy. The liver may weigh many pounds, and yet the specific gravity is so low that the entire organ floats in water.

The symptoms of fatty liver are not definite. Jaundice is never present; the stools may be light colored, but even in the most advanced grades the bile is still formed. Signs of portal obstruction are rare. Hæmorrhoids are not very infrequent. Altogether, the symptoms are ill defined, and are chiefly those of the disease with which the degeneration is associated. In cases of great obesity the physical examination is uncertain; but in phthisis and cachectic conditions the organ can be felt to be greatly enlarged, though smooth and painless. Fatty livers are among the largest met with at the bedside.

XI. AMYLOID LIVER

The waxy, lardaceous, or amyloid liver occurs as part of a general degeneration, associated with cachexias, particularly when the result of long-standing suppuration.

In practice, it is found oftenest in the prolonged suppuration of tuberculous disease, either of the lungs or of the bones. Next in order of frequency are the cases associated with syphilis. Here there may be ulceration of the rectum, with which it is often connected, or chronic disease of the bone, or it may be present when there are no suppurative changes. It is found occasionally in rickets, in prolonged convalescence from the infectious fevers, and in the cachexia of cancer.

The amyloid liver is large, and may attain dimensions equalled only by those of the cancerous organ. Wilks speaks of a liver weighing fourteen pounds. It is solid, firm, resistant, on section anæmic, and has a semitranslu-

pul. tuberc.

tubercu

cent, infiltrated appearance. Stained with a dilute solution of iodine, the areas infiltrated with the amyloid matter assume a rich mahogany-brown color.

There are no characteristic *symptoms* of this condition. Jaundice does not occur; the stools may be light-colored, but the secretion of bile persists. The physical examination shows the organ to be uniformly enlarged and painless, the surface smooth, the edge rounded, and the consistence greatly increased. Sometimes the edge, even in ~~very~~ great enlargement, is sharp and hard. The spleen ~~also~~ may be involved, but there are no evidences of portal obstruction.

The *diagnosis* of the condition is, as a rule, easy. Progressive and great enlargement in connection with suppuration of long standing or with syphilis is almost always of this nature. In rare instances, however, the amyloid liver is reduced in size.

In *leukæmia* the liver may attain considerable size and be smooth and uniform, resembling, on physical examination, the fatty organ. The blood condition at once indicates the true nature of the case.

XII. ANOMALIES IN FORM AND POSITION OF THE LIVER

In transposition of the viscera the right lobe of the organ may occupy the left side. A common and important anomaly is the tilting forward of the organ, so that the antero-posterior axis becomes vertical, not horizontal. Instead of the edge of the right lobe presenting just below the costal margin, a considerable portion of the surface of the lobe is in contact with the abdominal parietes, and the edge may be felt as low, perhaps, as the navel. This anteversion is apt to be mistaken for enlargement of the organ.

The "lacing" liver is met with in two chief types. In one the anterior portion, chiefly of the right lobe, is greatly prolonged, and may reach the transverse navel line, or even lower. A shallow transverse groove separates the thin extension from the main portion of the organ. The peritoneal coating of this groove may be fibroid, and in rare instances the deformed portion is connected with the organ by an almost tendinous membrane. The liver may be compressed laterally and have a pyramidal shape, and the extreme left border and the hinder margin of the left lobe may be much folded and incurved. The projecting portion of the liver, extending low in the right flank, may be mistaken for a tumor, or more frequently for a movable right kidney. Its continuity with the liver itself may not be evident on palpation or on percussion, as coils of intestine may lie in front. It descends, however, with inspiration, and usually the margin can be traced continuously with that of the left lobe of the liver. The greatest difficulty arises when this anomalous lappet ~~of the liver~~ is ~~either~~ naturally very thick and united to the liver by a very thin membrane, or when it is swollen in conditions of great congestion of the organ.

The other principal type of lacing liver is quite different in shape. It is thick, broader above than below, and lies almost entirely above the transverse line of the cartilages. There is a narrow groove just above the anterior border, which is placed more transversely than normal.

Movable Liver.—This rare condition has received much attention, and J. E. Graham collected 70 reported cases from the literature. In a very considerable number of these there has been a mistaken diagnosis. A slight grade of mobility of the organ is found in the pendulous abdomen of enteroptosis, and after repeated ascites.

The organ is so connected at its posterior margin with the inferior vena cava and diaphragm that any great mobility from this point is impossible, except on the theory of a meso-hepar or congenital ligamentous union between these structures. The ligaments, however, may show an extreme grade of relaxation (the suspensory 7.5 cm., and the triangular ligament 1 cm., in one of Leube's cases); and when the patient is in the erect posture the organ may drop down so far that its upper surface is entirely below the costal margin. The condition is rarely met with in men; 56 of the cases were in women.

I. DISEASES OF THE PANCREAS

I. PANCREATIC INSUFFICIENCY

Failure of the internal secretion is followed by disturbance in the carbohydrate metabolism, of the external secretion by disturbances of digestion, or by the injurious effects of the retained secretion. The low sugar tolerance, the chief sign of impairment of the internal secretion, has been considered under diabetes. Insufficiency of the external secretion is indicated by:

Changes in the Character of the Stools.—(*a*) Steatorrhœa.—The proportion of fat in the fæces varies; above 30 per cent. of the dried weight suggests pancreatic insufficiency. The stools are either oily like butter, or gray like asbestos. The ability to digest fat differs greatly and there are healthy persons who constantly have a high percentage of fat in the stools. Steatorrhœa may last for many years without impairment of health. There is also a disturbance in the normal ratio between the neutral fats and the fatty acids. Cammidge gives the following average figures: Normal per cent., total fats 21, neutral fats 11, fatty acids 10; malignant disease, total fats 77, neutral fats 50, fatty acids 27; chronic pancreatitis, total fats 50, neutral fats 32, fatty acids 18.

(*b*) Azotorrhœa, the presence of undigested proteid materials in the stools, has long been known as an association of pancreatic disease. Normally only 5 or 6 per cent. of the undigested proteids appears in the fæces, but in pancreatic disease as much as 30 or 40 per cent. may be recovered. Schmidt claims that the nuclear material of meat is digested by the pancreatic juice alone and that persistence of the nuclei of the meat fibres in the stools indicates defective tryptic digestion.

In jaundice due to malignant disease of the head of the pancreas stercobilin is absent; in that due to chronic pancreatitis or gall-stones it is either absent or present only in traces.

Cammidge's Pancreatic Reaction.—For details of the reaction the student must consult special manuals. It is claimed that the reaction is positive in all cases of active inflammatory changes in the pancreas, and that by this means

acute forms of pancreatitis can be differentiated from intestinal obstruction, and that by it chronic pancreatitis causing blocking of the common duct can be diagnosed from gall-stones. In malignant disease the reaction is negative in about three-fourths of the cases. It is unfortunate that Cammidge's work lacks confirmation. The studies (1911) at the Mayo clinic under Wilson's direction lead to the conclusion that "if knowledge of the clinical histories and other factors of the personal equation be eliminated, the end results, judged by Cammidge's own criteria, must be considered, as a means of diagnosing disease of the pancreas, as both valueless and misleading." From observations of Whipple and others it seems that rapid disintegration of any of the body cells, particularly the polynuclear leucocytes, may give rise to the reaction.

II. PANCREATIC NECROSIS

The entire series of pancreatic lesions, from hæmorrhage to gangrene, and from fat necrosis to pancreatic cyst, may result from tryptic auto-digestion (Chiari). This is met with under four conditions: (*a*) Trauma, as in gunshot wounds, blows, or perforation of a peptic ulcer. (*b*) Primary thrombosis in the venous radicles of the glands. (*c*) Obstruction of the free flow of secretion in the duct. (*d*) Entrance of the bile into the ducts.

In the mildest forms there are only a few small hæmorrhages or circumscribed areas of necrosis of the gland tissue with fat necrosis in the neighborhood; in severer forms groups of acini or the whole gland may be involved.

Fat necrosis occurs whenever the pancreatic juice, obstructed from any cause and dammed back on the gland, infiltrates its tissues, or escaping by the lymph spaces finds its way to structures at some distance from the gland. The necrosis is due to the fat-splitting ferment in the secretion (Opie).

Balser first called attention to this remarkable change which is found in the interlobular pancreatic tissue, in the mesentery, in the omentum, in the abdominal fatty tissue generally, and occasionally in the pericardial and subcutaneous fat. The necroses are most frequent in the acute and necrotic forms of pancreatitis, less common in the suppurative. In the pancreas the lobules are seen to be separated by a dead white necrotic tissue, which gives a remarkable appearance to the section. In the abdominal fat the areas are usually not larger than a pin's head; they at once attract attention, and may be mistaken, on superficial examination, for miliary tubercles or neoplasms. They may be larger; instances have been reported in which they were the size of a hen's egg. On section they have a soft tallowy consistence, and the substance is a combination of lime with certain fatty acids. The necroses may be crusted with lime, and in a man aged 80, who died of nephritis, I found the lobules of the pancreas entirely isolated by areas of fat necrosis with extensive deposition of lime salts.

III. HÆMORRHAGE

Both Spiess (1866) and Zenker (1874) were acquainted with hæmorrhage into the pancreas as a cause of sudden death, but the great medico-legal

importance of the subject was first fully recognized by F. W. Draper, of Boston, whose townsmen, Harris, Fitz, Whitney, and others, have contributed additional studies. In 4,000 autopsies Draper met with 19 cases of pancreatic hæmorrhage, in 9 or 10 of which no other cause of death was found. When the bleeding is extensive the entire tissue of the gland is destroyed and the blood invades the retro-peritoneal tissue. In other instances the peritoneal covering is broken and the blood fills the lesser peritoneum (see hæmoperitoneum). The hæmorrhage may be in connection with an acute pancreatitis or with necrotic inflammation of the gland.

The *symptoms* are thus briefly summarized by Prince: "The patient, who has previously been perfectly well, is suddenly taken with the illness which terminates his life. . . . When the hæmorrhage occurs the patient may be quietly resting or pursuing his usual occupation. The pain which ushers in the attack is usually very severe and located in the upper part of the abdomen. It steadily increases in severity, is sharp or perhaps colicky in character. It is almost from the first accompanied by nausea and vomiting; the latter becomes frequent and obstinate, but gives no relief. The patient soon becomes anxious, restless, and depressed; he tosses about, and only with difficulty can he be restrained in bed. The surface is cold and the forehead is covered with a cold sweat. The pulse is weak, rapid, and sooner or later imperceptible. The abdomen becomes tender, the tenderness being located in the upper part of the abdomen or epigastrium. Tympanites is sometimes marked. The temperature is usually normal or subnormal. The bowels are constipated."

IV. ACUTE PANCREATITIS

Acute Hæmorrhagic Pancreatitis.—In this form the inflammation is combined with hæmorrhage, and it is difficult to separate clearly the two processes.

Etiology.—A large majority of the cases occur in adult males. McPhedran has reported one in a nine months' old child. Many of the patients had been addicted to alcohol; others had suffered occasionally with severe pains and vomiting or with gall-stone colic. Peiser found that 8 out of 121 collected cases of acute pancreatitis were associated with parturition. He suggests that the changes bringing about the pancreatitis in these cases may be analogous to those occurring in the liver, kidneys, and other organs in eclampsia.

The pancreas is found enlarged, and the interlobular tissue infiltrated with blood, and perhaps with clots. The relation of gall-stones to the condition has been demonstrated by Opie, and they were present in four of five cases at the Johns Hopkins Hospital. The calculus may be very small, and situated in the diverticulum of Vater. Bile finding its way into the pancreas may cause hæmorrhagic inflammation. Injection of bile into the pancreatic ducts of dogs reproduces the lesion. The anatomical appearances are very characteristic. The tissues about the gland are infiltrated with blood and there may be fluid in the lesser peritoneum. Areas of fat necrosis are seen in the retroperitoneal fat, the mesocolon and mesentery. The gland itself is swollen and in section the stroma has a mottled dark brown appearance and the outlines of the acini may be lost. In a case which I have reported the

Diseases of Panc. Lecture 17

Ducts of pancreas — from biliary duct disease but rare —

Prob. often by hæmatogenic infection from abscess in pancreas

many come from gall bl. duodenal ulcer or colitis — appendix — more rare —

I.e. metastatic from some other focus.

Pan. abscesses. [illegible] a a hæmorrhagic.

[illegible] fat necrosis often [illegible] to lipase — many hæmorrhages in the

to trypsin digests walls of vessels. The ci. activated pan. juices

are [illegible] by Ca. salts. enters vasc. & produces of aseptic necrosis

may form a [illegible] which [illegible] trypsin (q. inhibit. substances

when hæmorrhage is a primary process — may contain [illegible] q

protein decomp. by trypsin)

[illegible] ulcer — [illegible] acute — subacute

1. [illegible] sudden severe epig. pain, shock, vomiting. profuse hæmorrhage into pan

death [illegible] in 3 days

2. acute — most sudden — less severe pain may [illegible] = mostly affected part

necrosis of pancreas — [illegible] = sepsis often to follow =

3. subacute — as limited to head — no hæm. or slight diastasis.

pain — often absent — nausea vomiting = [illegible] obstruction. exchange

:. of bile duct.

[illegible] aspirate may be useful

Lancet. Jan 6. 1915.

Stasis & infection an early cause. - most often in gall-stone by cholecystitis -
calculi usually in gall-bladder - multiple & small. rarely in ampulla.
when with obstr. & common duct in some. so directly arising. of bile into
duct & urinary only in small % of cases.

Symptoms Premonitory attacks of pain in some - in upper abdom. resembling
sugg. ulcer or gall-stones in some - Some vomiting in some.

Symptoms & acute abd. crisis like perf. ulcer. or intest. obstruction.
suddenness - pain in epig. pers. vomiting. constip.
tolerant tenderness in upper abdom. rigid. distension
pulse rapid - temp low or normal

Tendernes acute epig. & retroperitoneum pancreas outside
swelling rare - ecchymosis rare - glycosuria rare

over from p. 594.
Tr. gall-stone acute - immed. operation early drainage not if too severe shock.
wait recovery.

Lancet. J. A.M.A. Feb 1. 17.

acute haem. ac. gangrenous & ac. suppurative pan. an acute form of same process
pain vomiting - pat. usually quiet. p.m. abn. rare
collapse shock small pressure in radial artery.
distension & tenderness - Tumor rare before 3 day

semilunar ganglia were swollen, the nerve-cells indistinct, and there was an interstitial infiltration of round cells. The Pacinian corpuscles in the neighborhood of the pancreas were enormously swollen and œdematous.

Symptoms.—One of the most characteristic features is the suddenness of the onset, usually with violent colicky pain in the upper part of the abdomen. Nausea and vomiting follow, with collapse symptoms, more or less severe according to the intensity of the attack. The abdomen becomes swollen and tense and there is constipation. The temperature at first may be low; subsequently fever sets in, sometimes initiated by a chill. There may be early delirium. Collapse symptoms supervene, and death occurs usually from the second to the fourth day, or even earlier. The swelling and infiltration in the region of the pancreas necessarily involve the cœliac plexus, and the stretching of the nerves may account for the agonizing pain and the sudden collapse. Deep pressure on the upper part of the abdomen may give evidence of circumscribed resistance.

Diagnosis.—Intestinal obstruction or acute perforating peritonitis is usually suspected. Now that the condition has become better known, the diagnosis *intra vitam* has been made. "Acute pancreatitis is to be suspected when a previously healthy person or a sufferer from occasional attacks of indigestion is suddenly seized with a violent pain in the epigastrium followed by vomiting and collapse, and in the course of twenty-four hours by a circumscribed epigastric swelling, tympanitic or resistant, with slight elevation of temperature. Circumscribed tenderness in the course of the pancreas and tender spots throughout the abdomen are valuable diagnostic signs" (Fitz).

Acute Suppurative Pancreatitis—Pancreatic Abscess.—Etiology.—The etiology in a majority of cases is doubtful. Dyspeptic disturbances and trauma have preceded the onset in some instances. Gall-stones may be present. In many of the cases it is a sequel of acute hæmorrhagic pancreatitis. In 24 cases there was a single abscess; in 14 there were numerous small abscesses. In other instances there was a diffuse purulent infiltration. Some of the sequels are peri-pancreatic abscess, perforation into the stomach, the duodenum, or the peritoneum, and thrombosis of the portal vein.

Symptoms.—The symptoms of suppurative pancreatitis are not always well defined. In one case in my wards Thayer made a correct diagnosis. The patient, aged thirty-four, had had occasional attacks of severe pain and vomiting. This was followed by fever and delirium. A deep-seated mass was felt in the median line just above the umbilicus. Finney operated and found disseminated fat-necrosis and a deep-seated abscess with necrotic pancreatic tissue. The patient recovered. The course of the suppurative form is much more chronic. Icterus, fatty diarrhœa, and sugar in the urine have been met with in some cases. The presence of a tumor mass in the epigastrium is of the greatest moment.

Gangrenous Pancreatitis.—Complete necrosis of the gland, or part of it, may follow either hæmorrhage or hæmorrhagic inflammation, and in exceptional cases may occur after suppurative infiltration or after injury or the perforation of an ulcer of the stomach. In Fitz's monograph 15 cases are reported. Körte ~~has~~ increased ~~its~~ number to 40. Symptoms of hæmorrhagic pancreatitis may precede or be associated with it. Death usually follows in from ten to twenty days, with symptoms of collapse.

Anatomically the pancreas may present a dry necrotic appearance, but as a rule the organ is converted into a dark slaty-colored mass lying nearly free in the omental cavity or attached by a few shreds. In other instances the totally or partially sequestrated organ may lie in a large abscess cavity, forming a palpable tumor in the epigastric region. In two cases, reported by Chiari, the necrotic pancreas was discharged per rectum, with recovery.

V. CHRONIC PANCREATITIS

Forms.—Anatomically there are two forms:

(*a*) Interlobular pancreatitis which follows occlusion of the duct, or an infection, such as occurs in the presence of calculi, biliary or pancreatic, with which organisms of the colon group, streptococci, or occasionally the typhoid bacillus are associated. Even in advanced sclerosis of this type the islands of Langerhans are spared. It may occur as an independent affection. It is not at all uncommon in the bodies of adults to find the head of the pancreas extraordinarily hard and so dense that it feels like scirrhus; surgeons have long noted this. The condition is often present without symptoms of pancreatic disease during life. A very special form is the chronic interstitial pancreatitis which accompanies hæmochromatosis, ~~and which is~~ described elsewhere. Mayo Robson, Moynihan and other surgeons have called attention to the fact that sclerosis of the head of the pancreas may cause obstruction of the duct.

(*b*) Chronic interacinar pancreatitis is characterized by a diffuse fibrosis penetrating between the acini, with little or no involvement of the interlobular tissues. It may follow infection through the duct, but is more common in association with cirrhosis of the liver and arterio-sclerosis.

Symptoms.—It must be confessed that the clinical picture of chronic pancreatitis is very obscure, in spite of the good work done by our surgical colleagues. Cammidge, who has had the great advantage of seeing Mayo Robson's clinical cases, describes four types: (*a*) The dyspeptic, in which the disease is due to morbid conditions of the bowels, and the symptoms are mainly referred to the digestive organs. (*b*) The cholelithic, associated with the presence of gall-stones in the common duct; there is usually chronic jaundice and the dominant symptoms are hepatic. (*c*) A miscellaneous group in which the pancreatitis is secondary to malignant disease, etc. (*d*) The diabetic group with glycosuria, and into which the members of the preceding groups may merge in course of time.

Symptoms of pancreatic insufficiency of the internal or external secretion are generally present; there is pain after food, very often jaundice, and on deep pressure the head of the pancreas may sometimes be felt. Careful study of the urine and of the fæces gives important information. Cammidge's pancreatic reaction in the urine is, its author thinks, suggestive of active degenerative changes. Sugar may also be present. The stools may show both steatorrhœa and azotorrhœa.

Treatment.—Owing to the difficulty of diagnosis in the early stages it is impossible to speak positively in a great many cases, but in the forms which

Parental insufficiency - does it test out [illegible]

are associated with pain, jaundice, the presence of calculi, and infection of the ducts excellent results have followed free drainage of the bile passages.

So much influenced is our present picture of chronic pancreatitis by personal equation on the part of surgical and laboratory workers that we are not in a position to speak very definitely on several important points.

VI. PANCREATIC CYSTS

Of 121 cases operated upon 60 were in males and 56 in females; in 5 the sex was not given (Körte). Sixty-six of the cases occurred in the fourth decade. T. C. Railton's case (which is not in Körte's series), an infant aged six months, and Shattuck's case in a child of thirteen and a half months are the youngest in the literature. According to the origin Körte recognizes three varieties.

Varieties.—Traumatic Cases.—In this list of 33 cases 30 were in men and only 3 in women. Blows on the abdomen or constantly repeated pressure are the most common forms of trauma. One case followed severe massage. Usually with the onset there are inflammatory symptoms, pain, and vomiting, sometimes suggestive of peritonitis. The contents of the cyst are usually bloody, though in 13 of the traumatic cases it was clear or yellowish.

Cysts Following Inflammatory Conditions.—In 51 cases the trouble began gradually after attacks of dyspepsia with colic, simulating somewhat that of gall-stones. Occasionally the attack set in with very severe symptoms, suggestive of obstruction of the bowel. In this group the tumor appeared in 19 cases soon after the onset of the pain; in others it was delayed for a period of from a few weeks to two or three years. McPhedran has reported a remarkable instance in which the tumor appeared in the epigastrium with signs of severe inflammation. It was opened and drained and believed to be a hydrops of the lesser peritoneal cavity. Three months later a second cyst developed, which appeared to spring directly from the pancreas.

Cysts without Any Inflammatory or Traumatic Etiology.—Of 33 cases in this group 26 were in women. A remarkable feature is the prolonged period of their existence—in one case for forty-seven years, in one for between sixteen and twenty years, in others for sixteen, nine, and eight years, in the majority for from two to four years.

Morbid Anatomy.—Anatomically Körte recognizes (1) *retention cysts* due to plugging of the main duct; (2) *proliferation cysts* of the pancreatic tissue —and cysto-adenoma; (3) *retention cysts* arising from the alveoli of the gland and of the smaller ducts, which become cut off and dilate in consequence of chronic interstitial pancreatitis; (4) *pseudo-cysts* following inflammatory or traumatic affections of the pancreas, usually the result of injury, causing hæmorrhage and hydrops of the lesser peritoneum.

Situation.—In its growth the cyst may (1) be in the lesser peritoneum, push the stomach upward, and reach the abdominal wall between the stomach and the transverse colon; (2) more rarely the cyst appears above the lesser curvature and pushes the stomach downward; in both of these cases the situation of the tumor is high in the abdomen; but (3) it may develop between the leaves of the transverse meso-colon and lie below both the colon and the

stomach. The relation of these two organs to the tumor is variable, but in the majority of cases the stomach lies above and the transverse colon below the cyst. Occasionally, too, as in T. C. Railton's case, the cyst may arise in the tail of the pancreas and project far over in the left hypochondrium in the position of the spleen or of a renal tumor.

General Symptoms.—Apart from the features of onset already referred to, the patient may complain of no trouble unless the cyst reaches a very large size. Painful colicky attacks, with nausea and vomiting and progressive enlargement of the abdomen, have frequently been noted. Fatty diarrhœa from disturbance of the function of the pancreas is rare. Sugar in the urine has been present in a number of cases. Increased secretion of the saliva, the so-called pancreatic salivation, is also rare. Pressure of the cyst may sometimes cause jaundice, and in rare instances dyspnœa. Very marked loss of flesh has been present in a number of cases. A remarkable feature often noticed has been the transitory disappearance of the cyst. In one of Halsted's cases the girth of the abdomen decreased from 43 to 31 inches in ten days with profuse diarrhœa. Sometimes the disappearance has followed blows.

Diagnosis.—The cyst occupies the upper abdomen, usually forming a semicircular bulging in the median line, rarely to either side. In 16 cases Körte states that the chief projection was below the navel. In one case operated upon by Halsted the tumor occupied the greater part of the abdomen. The cyst is immobile, respiration having little or no influence on it. As already mentioned, the stomach, as a rule, lies above it and the colon below.

In a majority of the cases the fluid is of a reddish or dark-brown color, and contains blood or blood coloring matter, cell detritus, fat granules, and sometimes cholesterin. The consistence of the fluid is usually mucoid, rarely thin. The reaction is alkaline, the specific gravity from 1.010 to 1.020. In 22 cases Körte states that the fluid was not hæmorrhagic.

The existence of ferments is important. In 54 cases they were present in the fluid or in the material from the fistula. In 20 cases only one ferment was present, in 20 cases two, and in 14 cases all three of the pancreatic ferments were found. In view of the wide occurrence of diastatic and fat-emulsifying ferments in various exudates, the ~~most important and~~ only positive sign in the diagnosis of the pancreatic secretion is the digestion of fibrin and albumin.

Operation.—Of 160 cases of operation there were 150 recoveries. Incision and drainage was ~~the operation~~ performed in 138 cases, in 15 excision. ~~was an performed~~.

VII. TUMORS OF THE PANCREAS

Of new growths in the organ carcinoma is the most frequent. Sarcoma, adenoma, and lymphoma are rare.

Frequency.—At the General Hospital in Vienna in 18,069 autopsies there were 22 cases of cancer of the pancreas (Biach). In 11,472 post mortems at Milan Segré found 132 tumors of the pancreas, 127 of which were carcinomata, 2 sarcomata, 2 cysts, and 1 syphiloma. In 6,000 autopsies at Guy's Hospital there were only 20 cases of primary malignant disease of the organ (Hale White). In the first 1,500 autopsies at the Johns Hopkins Hospital

there were 6 cases of adeno-carcinoma, and 1 doubtful case in which the exact origin could not be stated. There were 8 cases of secondary malignant disease of the pancreas. The head of the gland is most commonly involved, but the disease may be limited to the body or to the tail. The majority of the patients are in the middle period of life.

Symptoms.—The diagnosis is not often possible. The following are the most important and suggestive features: (*a*) Epigastric pains, often occurring in paroxysms. (*b*) Jaundice, due to pressure of the tumor in the head of the pancreas on the bile-duct. The jaundice is intense and permanent, and associated with dilatation of the gall-bladder, which may reach a very large size. (*c*) The presence of a tumor in the epigastrium. This is very variable. In 137 cases Da Costa found the tumor present in only 13. Palpation under anæsthesia with the stomach empty would probably give a very much larger percentage. As the tumor rests directly upon the aorta there is usually a marked degree of pulsation, sometimes with a bruit. There may be pressure on the portal vein, causing thrombosis and its usual sequels. (*d*) Symptoms due to loss of function of the pancreas are less important. Fatty diarrhœa is not very often present. In consequence of the absence of bile the stools are usually very clay-colored and greasy. Diabetes also is not common. (*e*) A very rapid wasting and cachexia. Of other symptoms nausea and vomiting are common. In some instances the pylorus is compressed and there is great dilatation of the stomach. In a few cases there has been profuse salivation.

The points of greatest importance in the diagnosis are the intense and permanent jaundice, with dilatation of the gall-bladder, rapid emaciation, and the presence of a tumor in the epigastric region. Of less importance are features pointing to disturbance of the functions of the gland.

Of other new growths sarcoma and lymphoma have been occasionally found. Miliary tubercle is not very uncommon in the gland. Syphilis may occur as rather a chronic interstitial inflammation, or in the form of gummata.

The outlook in tumors of the pancreas is, as a rule, hopeless; but of late years a number of successful cases of operation have been reported.

VIII. PANCREATIC CALCULI

Pancreatic lithiasis is comparatively rare. In 1883 George W. Johnston collected 35 cases in the literature. In 1,500 autopsies at the Johns Hopkins Hospital there were 2 cases.

The stones are usually numerous, either round in shape or rough, spinous and coral-like. The color is opaque white. They are composed chiefly of carbonate of lime. The effects of the stones are: (1) A chronic interstitial inflammation of the gland substance with dilatation of the duct; sometimes there is cystic dilatation of the gland; (2) acute inflammation with suppuration; (3) the irritation of the stones, as in the gall-bladder, may lead to carcinoma.

Symptoms.—The cases are not often diagnosed. Pains in the epigastrium, often very severe, but not characteristic; the signs of pancreatic insufficiency already described, and the X-rays, ~~which show the pancreatic but not the biliary concretions,~~ are suggestive features. An analysis of the calculi passed

with the stools may alone serve to distinguish a case from one of gall-stones. Operation has been performed successfully.

J. DISEASES OF THE PERITONEUM

I. ACUTE GENERAL PERITONITIS

Definition.—Acute inflammation of the peritoneum.

Etiology.—The condition may be primary or secondary.

(*a*) Primary, Idiopathic Peritonitis.—Considering how frequently the pleura and pericardium are primarily inflamed, the rarity of idiopathic inflammation of the peritoneum is somewhat remarkable. It may follow cold or exposure and is then known as "rheumatic" peritonitis. In Bright's disease, gout, and arterio-sclerosis acute peritonitis may occur as a terminal event. Of 102 cases of peritonitis which came to autopsy at the Johns Hopkins Hospital, 12 were of this form.

(*b*) Secondary peritonitis is due to extension of inflammation from, or perforation of, one of the organs covered by the peritoneum. Peritonitis from extension may follow inflammation of the stomach or intestines, ulceration in these parts, cancer, acute suppurative inflammations of the spleen, liver, pancreas, retroperitoneal tissues, and the pelvic viscera.

Perforative peritonitis is the most common, following external wounds, perforation of an ulcer of the stomach or bowels, perforation of the gall-bladder, abscess of the liver, spleen, or kidneys. Two important causes are appendicitis and suppurating inflammation about the Fallopian tubes and ovaries. There are instances in which peritonitis has followed rupture of an apparently normal Graafian follicle.

Of the above 102 cases, 56 originated in an extension from some diseased abdominal viscus. The remaining 34 followed surgical operations upon the peritoneum or the contained organs.

The peritonitis of septicæmia and pyæmia is almost invariably the result of a local process. An exceedingly acute form of peritonitis may be caused by the development of tubercles on the membrane.

Morbid Anatomy.—In recent cases, on opening the abdomen the intestinal coils are distended and glued together with lymph, and the peritoneum presents a patchy, sometimes a uniform injection. The exudation may be: (*a*) Fibrinous, with little or no fluid, except a few pockets of clear serum between the coils. (*b*) Sero-fibrinous. The coils are covered with lymph, and there is in addition a large amount of a yellowish, sero-fibrinous fluid. In instances in which the stomach or intestine is perforated this may be mixed with food or fæces. (*c*) Purulent, in which the exudate is either thin and greenish yellow in color, or opaque white and creamy. (*d*) Putrid. Occasionally in puerperal and perforative peritonitis, particularly when the latter has been caused by cancer, the exudate is thin, grayish green in color, and has a gangrenous odor. (*e*) Hæmorrhagic. This is sometimes found as an admixture in cases of acute peritonitis following wounds, and occurs in the cancerous and tuberculous forms. (*f*) A rare form occurs in which the injec-

naphthiro]

ephinephrine with KI pneumothorax Sodium or removal of pleural

Hiccups Method by pressure on eyeballs.

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Sodium iodide - subcutaneously - 10% soln. 2-3 times a week

as 5-10 gm. a dose intraspinal 30-50 gm. a dose. or not over 15 gm.

Sod. salicylate 600- 100 cc. of 5-10% soln.

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